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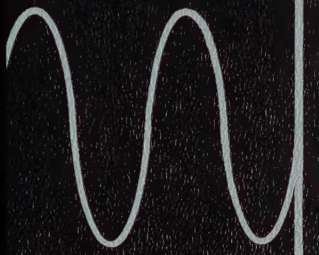

SPECTRAL DYNAMICS CORPORATION

SERIAL 96

SDC
S-20

INSTRUCTION MANUAL

MODEL 13151 SPECTROGRAM DISPLAY CONTROL

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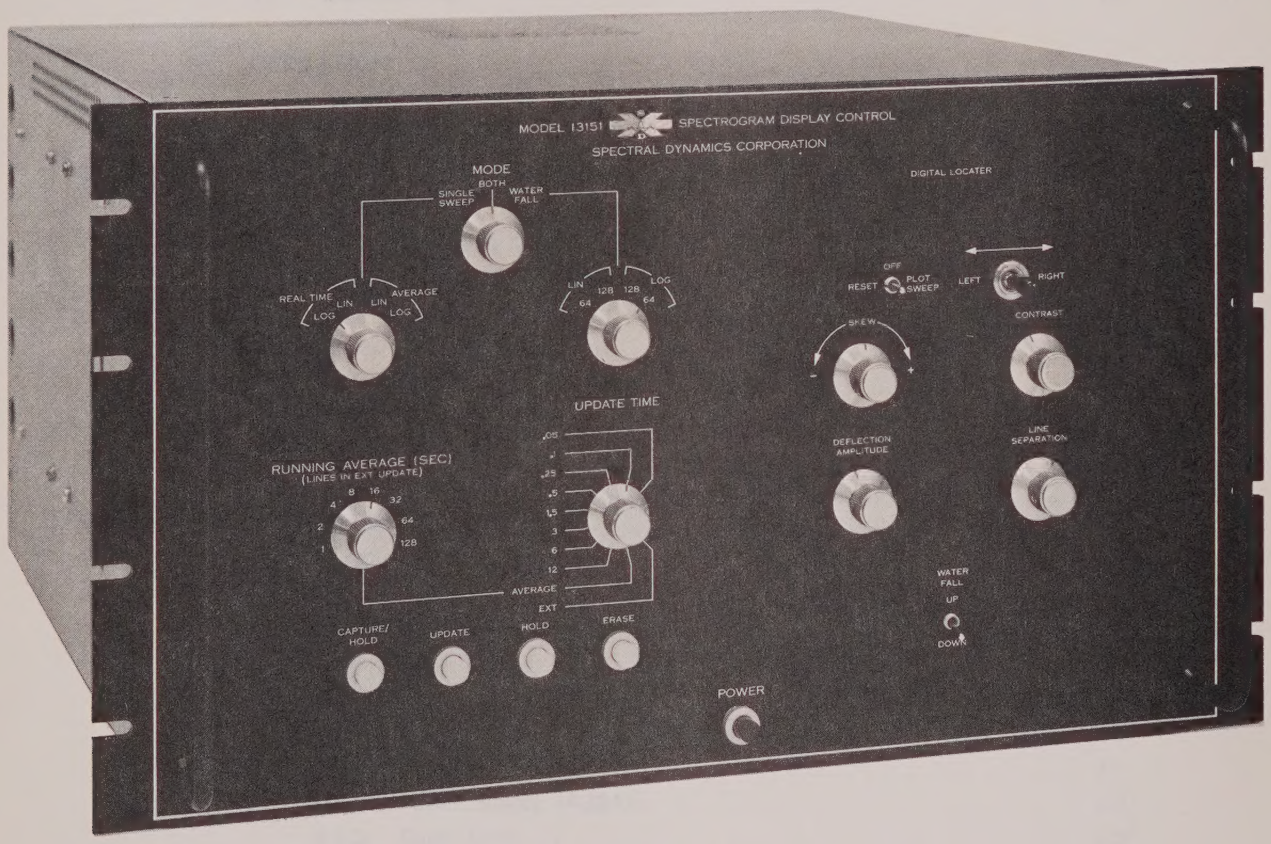

MODEL 13151 SPECTROGRAM DISPLAY CONTROL

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LIST OF DRAWINGS

(Located at Rear of Manual)

Schematic and Component Layout Drawings:

Circuit Card	Description	DWG. NO.
A1	Clock and X Ramp	27525000
A2	Counter	27526000
A3	Ladder (10 Bit)	27526300
A5	Memory Control	27527800
A6–A13	Memory	27525600
A14	Avgr–W/F Memory Control	27526900
A15	Memory Data	27535100
A20	Binary to BCD Converter	27531000
A21	Cursor	27529000
A22	Plotter Output	27525700
A23	Input Buffer Control	27529600
A24	10-Bit A/D Converter	10098700
A25	Input Buffer Memory	27525500
A26	Adder–Running Avgr	27527200
A27	Memory–Running Avgr	27529300
A28	Real Time Avgr	27527500
A29	Digital Log Switch	27528400
A30	12-Bit Ladder	27528700
A31A1	Numeric Indicator	27530300
A31A2	Output Amplifier	27526600
	Interconnect Diagram, Front Panel Assembly A31	27529700
	Interconnect Diagram, Power Supply Assembly A32 (P.C. Assembly 19304-1, A32A1)	27533700
	Interconnect Diagram, Main Frame Assembly A33	27529900

PREFACE

RECEIVING INSPECTION PROCEDURE

The Model 13151 Spectrogram Display Control is shipped fully assembled, packed in a polystyrene case designed to protect it against all normal shipping hazards. Immediately upon receipt, inspect the exterior of the shipping case and note any visible damage. Keep all forms and invoices attached to the shipping case. Remove the instrument from the shipping case and test its functional operation. If shipping damage is apparent, file a claim with the carrier's claims agent and send a copy to Spectral Dynamics Corporation. Be sure to include the instrument name, model number, and serial number on all correspondence. Spectral Dynamics Corporation will advise the buyer what should be done; arrangements for repair or replacement will be made as applicable.

WARRANTY POLICY

All Spectral Dynamics products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain components listed in some of the operating manuals, for the specified period. We will repair or replace products which prove to be defective during the warranty period, providing the failure or damage has not been caused by misuse or abnormal operating conditions. Fuses and lamps are specifically excluded from warranty. If the malfunction or a portion thereof is determined by Spectral Dynamics Corporation to have been caused by misuse or abnormal conditions of operation, an estimate of cost to repair will be submitted to the purchaser for approval before beginning any repair work.

Liability under this warranty is limited to servicing and adjusting the instrument returned to the factory, with transportation charges prepaid by the purchaser. No other warranty is expressed or implied. We are not liable for consequential damages.

If any malfunction develops, notify Spectral Dynamics Corporation or its representative in your area, giving details of the problem, and the name, model and serial number of the equipment. Upon receipt of this information, service data or shipping instructions will be provided.

RETURN SHIPMENT PROCEDURE

On receipt of shipping instructions, forward the instrument prepaid via air freight to the factory or authorized repair station indicated on the instructions. Replace the instrument in its original shipping case, or equivalent container.

SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

The Model 13151 Spectrogram Display Control unit formats the output data from instruments such as the SDC Model SD301 (series) Real Time Analyzer or the SDC Model 13178 Time-Gram Adaptor, into a spectrogram display. The spectrogram is generally displayed on an SDC Model 13116-2 X-Y Display, large-screen oscilloscope. See Figure 1-1.

Operator selected formats are available in single, 64, or 128 spectra lines; or a combination single and 64-line spectrogram. Each line is made up of 500 data points. The spectrogram provides a moving "waterfall" spectrum-past history record that can be updated at 8 selectable rates from 0.05 to 12 seconds. As the oldest data is replaced, it is available in a non-redundant format for hardcopy recording on a fiberoptic oscillograph recorder. Also available is an X-Y plotter output which represents an averaged spectrum.

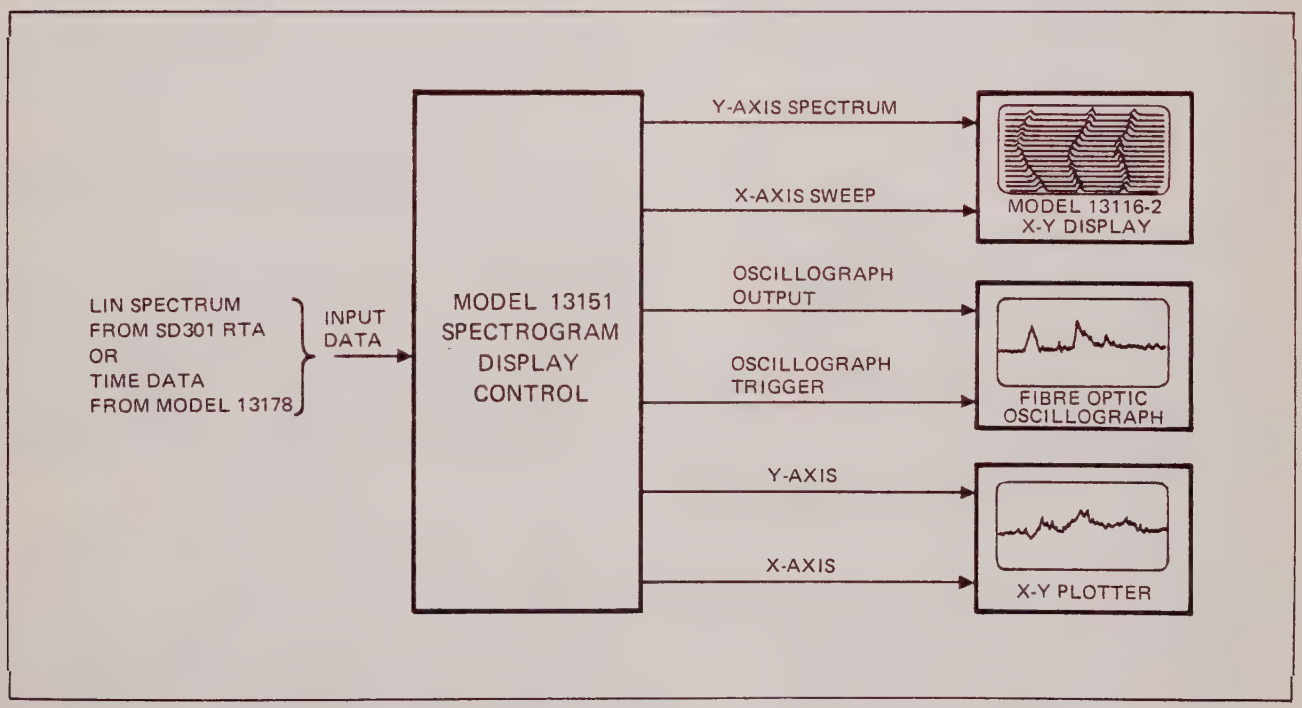


Figure 1-1. Concept of Operation

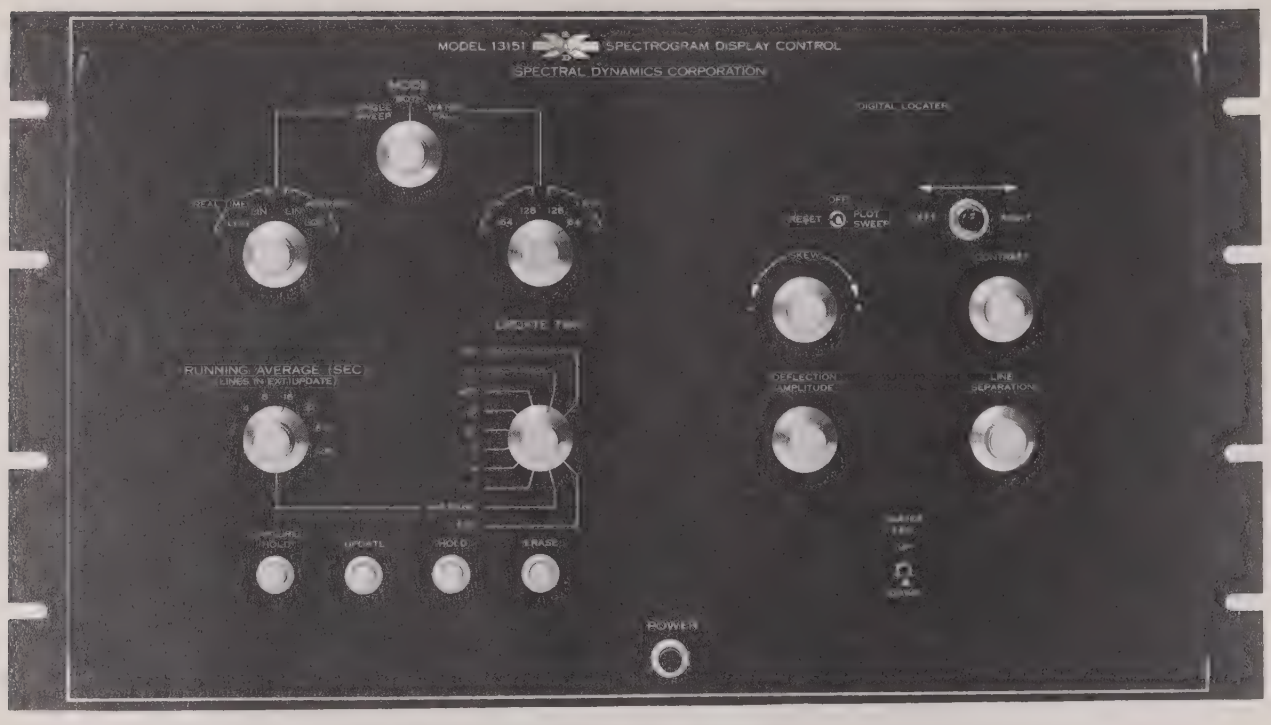


Figure 1-2. Front Panel

1.2 FRONT-PANEL FUNCTIONAL DESCRIPTION

The following paragraphs briefly describe the function of each of the front-panel controls and indicators illustrated in Figure 1-2.

NOTE

Except where noted otherwise, the following descriptions assume that the INPUT data is the LIN SPECTRUM output data from an SDC Model SD301 (series) Real Time Analyzer. The "X," "Y," and "Z" outputs are applied to an SDC Model 13116-2 X-Y Display (large screen CRT).

MODE Selector

Setting determines the type of display to be outputed as described below.

SINGLE SWEEP MODE

A single X-axis sweep is outputed every 250 microseconds. The Y-axis parameters are determined by the setting of the REAL TIME/AVERAGE selector.

REAL TIME/AVERAGE Selector

In either LOG or LIN REAL TIME position, the INPUT data is formatted and processed for display as it arrives (in real time).

Note that in REAL TIME LOG or AVERAGE LOG position, an internal log converter converts the INPUT data to log form.

In either LIN or LOG AVERAGE position, the INPUT data is averaged before being formatted and outputed for display. The INPUT data is averaged over the time selected by the RUNNING AVERAGE (SEC) switch. Note that this switch selects a time constant; four time constants are required for signals to reach their final value.

WATERFALL MODE

As selected by the associated LIN/LOG selector, either a 64-line or 128-line spectrogram is formatted into memory for outputing to the display. The overall presentation is affected by the UPDATE TIME, RUNNING AVERAGE, WATERFALL UP/DOWN, DEFLECTION AMPLITUDE, LINE SEPARATION, CONTRAST, and SKEW controls which are described later.

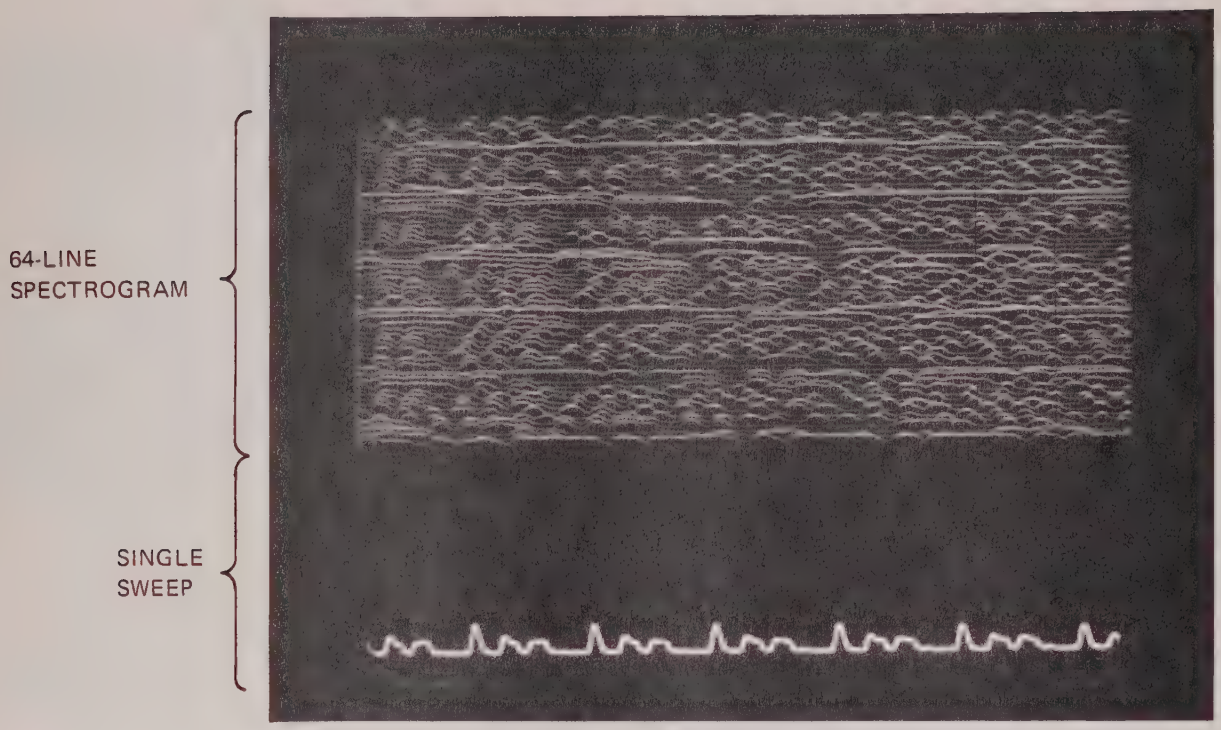


Figure 1-3. Typical "BOTH" Mode Display

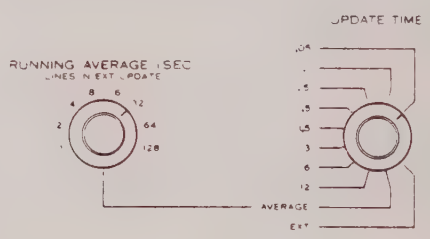
BOTH MODE

In this mode, the output presentation is divided into two parts: a single sweep at the bottom portion and a 64-line waterfall spectrogram at the top as shown in Figure 1-3. The single sweep can be adjusted by the REAL TIME/AVERAGE selector and associated switches as previously described. The waterfall spectrogram presentation is affected by the WATERFALL LIN/LOG selector and associated switches previously described, but only a 64-line spectrogram will be displayed in the waterfall portion in the BOTH mode.

UPDATE TIME Selector

Used in the WATERFALL MODE to select update times, averaging, or external updating.

Positions .05 through 12 are calibrated in seconds. The selected position determines the time period between updates of the waterfall spectrogram. For example, if set to "3," a new line is added at the top (or bottom) of the display, while a line is deleted from the bottom (or top) of the display, every 3 seconds.

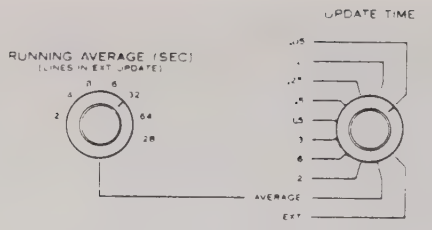


In the AVERAGE position, each updated line of the waterfall display is the average value of the INPUT, with the time as set by the RUNNING AVERAGE (SEC) switch. Therefore, the RUNNING AVERAGE switch setting determines the update rate. In this mode, the switch positions (1, 2, 4, $\cdots$ 128) are calibrated in seconds.

In EXT position, the waterfall display is updated after an external pulse is applied.

RUNNING AVERAGE (SEC) Switch

As previously described above, this switch performs three functions as follows:



In SINGLE SWEEP AVERAGE mode, the setting determines the time in seconds over which the INPUT data is averaged. Note that this is a time-constant; four time-constants are required for signals to reach their final value.

In any WATERFALL mode, with the UPDATE TIME switch set to AVERAGE, the setting determines the time in seconds over which averaging will occur between line updates of the waterfall spectrogram.

In the EXT mode, a running average of the INPUT data ensembles can be automatically controlled as a function of the number of ensembles applied. In this case, the UPDATE TIME switch is set to EXT, and the number of ensembles to be averaged between each update is equal to the numerical setting of the RUNNING AVERAGE switch.

Push Button Switch/Indicator Mode Control Group

Except for the POWER push button, each of these is a momentary contact press-and-release type push button. The push button that is pressed lights, and stays lighted as long as the particular mode is operating.

UPDATE Push Button

When lighted, the spectrogram is updated in accordance with the settings of the MODE selector and associated switches described above.

HOLD Push Button

Pressed to manually stop any updating mode. An update in progress will be completed, but then the memory contents will be continuously recycled (no new data entered) until an UPDATE or a CAPTURE/HOLD mode is initiated.

CAPTURE/HOLD Push Button

When pressed, the spectrogram will be updated for 64 or 128 lines (as selected by the MODE selector), and then automatically go into HOLD mode; i.e., the CAPTURE/HOLD indicator is extinguished and the HOLD push button lights.

ERASE Push Button

Note that this push button is electrically interlocked with the UPDATE push button; that is, to erase the data in the output memory, first the UPDATE push button must be pressed and held in; then the ERASE button is pressed and released. The data on display will be completely erased. When the UPDATE button is released, normal updating of the display will be resumed.

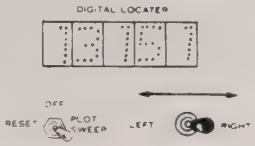
POWER Push Button Switch/Indicator

Pressed to turn instrument on or off; lighted when power is on.

DIGITAL LOCATER Indicator and Control Group

A cursor mark can be manually positioned on the spectrogram display; the DIGITAL LOCATER, a 5-digit LED readout, continuously indicates the cursor location. the DIGITAL LOCATER is calibrated in frequency (Hz) or cell number (0 to 500) as described below:

When the Model 13151 is interconnected with an SD301 RTA and ANALYSIS RANGE (frequency) information is available, the DIGITAL LOCATER indicates the cursor location in frequency (Hz). If frequency range information is not available, the DIGITAL LOCATER indicates the cell number (0 to 500) over which the cursor is located.



The cursor mark (intensified spot) always appears at the peak (top) of the signal amplitude of the particular cell location over which it is placed.

PLOT SWEEP Switch and LEFT/RIGHT Slewing Switch

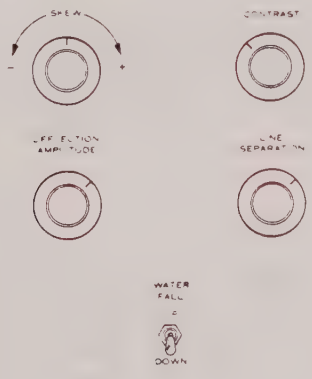
In the center OFF position, the cursor can be moved left or right on the display with the LEFT/RIGHT slewing switch. Slewing stops at either extreme and

when the switch is returned to the center position. Both LEFT and RIGHT slewing switch positions provide 2-speed slewing rates, 20 cells per second and 100 cells per second.

The cursor can be reset to zero (extreme left-hand side of display) by momentarily pressing the switch to RESET; the switch spring-returns to OFF when released. With the switch set to PLOT SWEEP, the cursor will automatically track along with the X-axis sweep as it moves across the face of the display oscilloscope. In like manner, the DIGITAL LOCATER will provide a continuous readout of the cursor location.

Display Control Group

This group of controls affects some of the overall parameters of the spectrogram display, such as the shape, size, contrast, etc.



CONTRAST Control

Adjusted for desired contrast between spectrum data and the normal sweep lines in the waterfall display. Rotate clockwise to increase the intensity of the spectrum data as a function of the signal amplitude.

DEFLECTION AMPLITUDE Control

Adjusted clockwise to increase the amplitude of the waterfall spectrum data.

LINE SEPARATION Control

Adjusted clockwise to increase or counter-clockwise to decrease the vertical distance between the lines of a waterfall display.

WATERFALL UP/DOWN Switch

In UP position, waterfall display is updated at the bottom line; hence, waterfall appears to move upward. In DOWN position, waterfall is updated at the top line; hence waterfall appears to move downward.

SKEW Control

Used to tilt a waterfall display to the left (–) or right (+) as shown below:

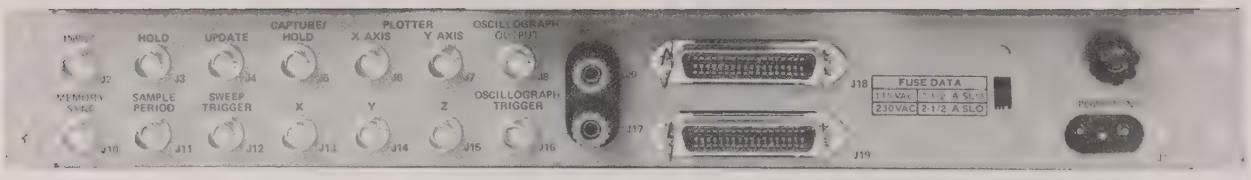


Figure 1-4. Rear of Chassis

1.3 REAR-OF-CHASSIS FUNCTIONAL DESCRIPTION

The following paragraphs briefly describe the functions of each connector, switch, and fuse on the rear of the chassis illustrated in Figure 1-4.

J1 – POWER IN

Accepts 3-wire plug and cable (supplied) for applying 115/230 Vac 50–400 Hz primary input power. Center terminal is chassis ground. Uses Belden No. 17258-S cable.

J2 – INPUT

Accepts the input data to be formatted for display; either the SPECTRUM LIN output from an SDC Model SD301 RTA, or time data output from an SDC Model 13178 Time-Gram Adaptor.

J3 – HOLD
J4 – UPDATE
J5 – CAPTURE/HOLD

Application of a momentary ground signal to any of these inputs will initiate the function described for the front-panel push button having corresponding nomenclature.

J6 – PLOTTER X-AXIS Output

Provides a 0–1V sweep ramp; sweep period times are 25 or 50 seconds. Used with PLOTTER Y-AXIS described below.

J7 – PLOTTER Y-AXIS Output

Provides the spectrum data output (0–5V for each data point) to an X-Y recorder; used with J6 output described above.

J8 – OSCILLOGRAPH OUTPUT

Provides a high speed (250-microsecond) spectrum output for use by a fiberoptic recorder. The associated sweep signal is outputed at J16, OSCILLOGRAPH TRIGGER.

J9, J17 – PEN LIFT

Provide a set of relay contacts (isolated from ground) that are closed only during a plotter sweep. Refer to the "CAUTION" of Paragraph 2.4.3.

J10 – MEMORY SYNC Input

Accepts the MEMORY SYNC signal from an SD301 RTA. This signal is a 5V, approximately 4-microsecond pulse that occurs each time the RTA memory recirculates.

J11 – SAMPLE PERIOD Input

Accepts the SAMPLE PERIOD output from an SDC Model 13178 Time-Gram Adaptor. This signal is a 5V, approximately 4-microsecond pulse that occurs at the start of each sample period selected by the Model 13178.

J12 – SWEEP TRIGGER Input

Accepts the SWEEP TRIGGER output from an SDC Model SD301 or Model 13178. This signal, 5V to 0V transition, is synchronized with the start of each sweep. At the end of a sweep, transition back to 5V occurs for 250 microseconds minimum.

J13 – X Output
J14 – Y Output
J15 – Z Output

Provide the sweep (X), spectrum data (Y), and intensity (Z) signals for application to an SDC Model 13116-2 X-Y Display.

J16 – OSCILLOGRAPH TRIGGER Output

Provides a 5V, 256-microsecond signal whenever the waterfall is updated, for use with the OSCILLOGRAPH OUTPUT, J8, described above.

J18 – Aux Functions

Accepts spectrum data in a compatible digital format. Refer to Table 2-1 in Section II for pin functions.

J19 – Aux Functions

Provides interface connections with a Model SD301 RTA. Refer to Table 2-2 in Section II for pin functions. Interconnection cable details are given in Appendix A.

115/230 Switch

Facilitates changeover of primary power input circuit for either 115V or 230V operation. Proper input voltage to be applied shows in window; screwdriver blade slot is up for 115V operation and down for 230V operation.

F1 – Fuse Holder

Contains 3AG type, 2-1/2A, SLO-BLO fuse.

1.4 SPECIFICATIONS

INPUTS

From SD301 Series Real Time Analyzers

Spectrum Lin . . .
0 to 5V output; one step for each synthesized filter location

Spectrum Log . . .
1V (nominal log output of detector)

Frequency . . .
0–5V ramp

Sweep Trigger . . .
A change from 5V to 0V synchronized with start of sweep – returns to 5V at the end of sweep

Memory Sync . . .
A change from 0 to 5V (nominally 2 μs min.) at the beginning of each memory recirculation.

External

Data . . .
Analog 0–5V or Digital 3 to 10 bits; 0–0.5V true (1); 2.4–5V false (0)

Line Sync . . .
5V (nominal) pulse, the transition from 5V to 0V signifies start of line. Rep. rate 0–60 Hz

Word Sync . . .
5V (nominal) pulse, signifies data to be inputed on data line. Rep. rate 0–30 kHz

OUTPUTS

To SDC Model 13116-2 X-Y Display

X Axis . . .
0–1V ramp (B.W.–dc–2 MHz)

Y Axis . . .
0–1V in single sweep only

Z Axis . . .
0–5V (B.W. dc–2 MHz)

To Fiberoptic Recorder

Trigger . . .
1V pulse

Spectrum . . .
0 to –5V, 250 μs presentation

To X-Y Plotter

Operation . . .
Simultaneously an integrated display is plotted without disturbing the refreshed CRT display. Plot times of 25 or 50 seconds.

X Axis . . .
0–1V

Y Axis . . .
0–5V

Pen Lift . . .
Isolated contact closure provided to lower pen

OPERATIONS

Mode Selection (for CRT display)

Waterfall . . .
500 word linear or log of 64 spectra with 6 bit words or 128 spectra with 3 bit words with real time or averaged data (500 x 6 = 192K bits storage)

Single Sweep . . .
500 word linear or log of real time or averaged

Both . . .
64 line and single sweep spectra

Running Average

Time Constants . . .
(digital R-C averaging)
τ = 1, 2, 4, 8, 16, 32, 64, 128 seconds (SD301 input) or lines (external input)
Memory Capacity . . .
500 – 16 bit words

Waterfall operator interactive* controls

*Skew . . .
Time axis can be tilted either left or right
*Deflection Amplitude . . .
Data Y axis deflection per spectrum can be varied from zero to 10% of total CRT deflection
*Line Separation . . .
Individual spectrum spacing can be varied from zero to 10% of total CRT deflection
*Contrast . . .
Data value can be used to control the intensity from no effect to on-off intensity modulation
Frequency and/or
*Digital Locater . . .
Five-place light emitting diode (LED) readout corresponding to an intensity marker on the CRT, the intensity marker is controlled by a left-right joystick

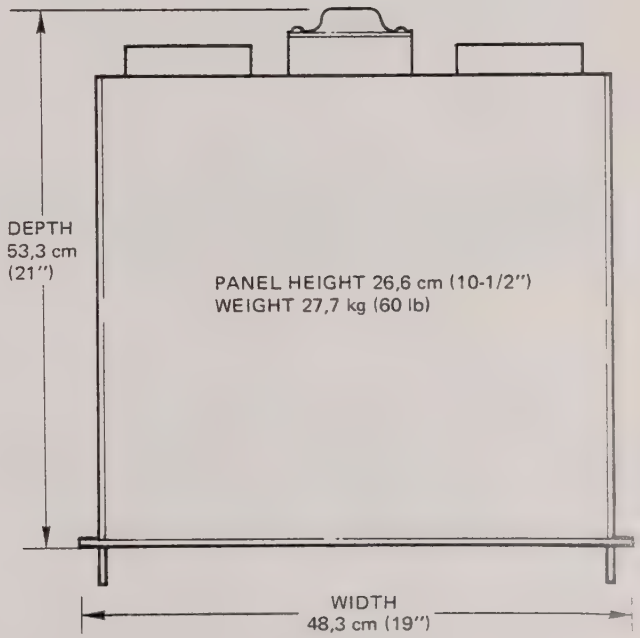
*Displayed data can be modified.

Other Waterfall Controls

Up/Down . . .
Direction of waterfall can be selected for desired effect
Update . . .
Memory continuously updates with new input data
Hold . . .
Data in memory is continuously recycled – no new data is entered
Capture/Hold . . .
64 or 128 (as selected) spectra are entered – then hold is automatically selected
Update Time . . .
Update rate selectable as
– real time data every 0.05, 0.1, 0.25, 0.5, 1.5, 3.0, 6.0, or 12.0 seconds
– averaged data at averager time constant (1, 2, 4, · · · 128 seconds)
– external pulse rate

Power . . .
105–125/210–250 Vac (switch-selectable);
50 to 400 Hz, ≈150W

Dimensions:



SECTION II

OPERATION

2.1 GENERAL

The Model 13151 was specifically designed to operate with a Model SD301C RTA or a Model 13178 Time-Gram Adaptor, or other instruments that can provide the required input signals. The output spectrogram formatted by the 13151 is generally applied to a Model 13116-2 X-Y Display, large-screen oscilloscope. Therefore, the following operating procedures assume that the 13151 is interconnected as shown in Figure 2-1 (using an SD301C) or as shown in Figure 2-2 (using a 13178).

It is recommended that the operator refer to Section I of this manual and study carefully the functional descriptions of all front-panel and rear-of-chassis controls, indicators, switches, and connectors. For detailed information concerning the setup and operation of the SD301C or 13178, refer to their respective instruction manuals.

2.2 OPERATIONAL CHECKOUT PROCEDURE

a. Before applying power, check that the 115/230 switch on the instrument rear-of-chassis is set to the input line voltage and the proper value fuse is installed.

b. Connect power cable (supplied) to primary power source.

c. Press the front-panel POWER push button; it should light to indicate that power is applied to all internal circuits.

d. Interconnect the Model 13151, SD301C or Model 13178, and a Model 13116-2 (or equivalent). See applicable Figure 2-1 or 2-2. (For interconnection cable details, refer to Appendix A.)

e. Apply a data signal source to the input of the SD301C (or 13178).

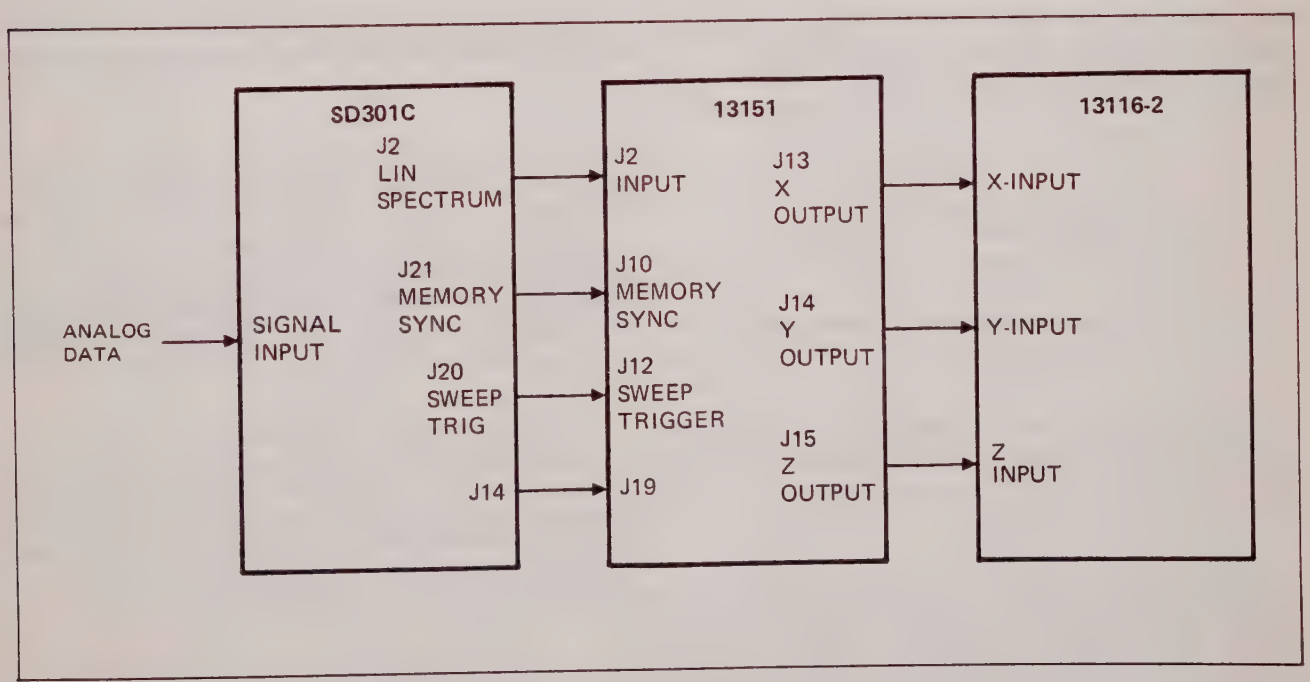


Figure 2-1. Setup for Operation With Model SD301C Real Time Analyzer

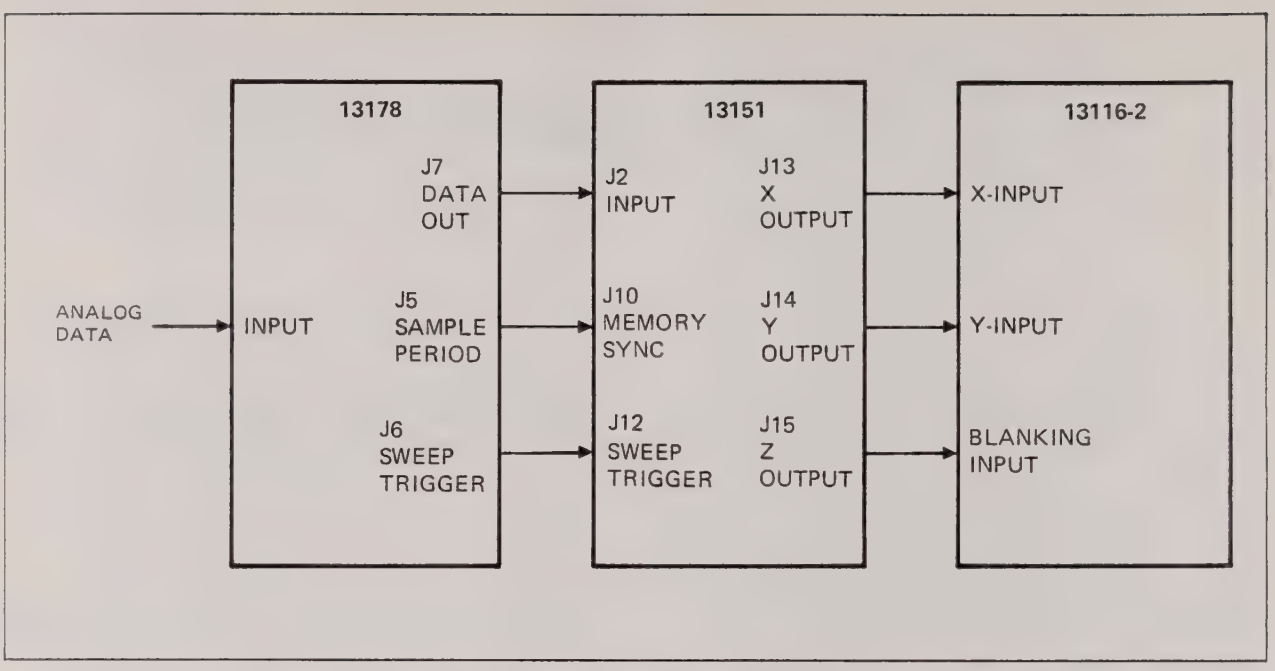


Figure 2-2. Setup for Operation With Model 13178 Time-Gram Adaptor

f. On 13151, set MODE selector to SINGLE SWEEP, and REAL TIME/AVERAGE switch to REAL TIME LIN.

g. Adjust 13116-2 for a single sweep display.

h. On 13151, set REAL TIME/AVERAGE switch to REAL TIME LOG. Observe change from linear to log presentation on output display.

NOTE

If excessive noise appears along the baseline in REAL TIME, SINGLE SWEEP, LOG mode, refer to subparagraph 2.4.2 under Paragraph 2.4, Special Operating Considerations.

i. On 13151, set REAL TIME/AVERAGE switch to AVERAGE LIN; set RUNNING AVERAGE (SEC) switch to 8.

j. Increase the frequency of the input data source and observe that the data display slowly moves towards new values. For example, if an SD301C is being used, the spectrum data peaks will move slowly to the right as the input signal frequency is increased.

k. On 13151, set REAL TIME/AVERAGE switch to AVERAGE LOG, and observe change from linear to log presentation on output display.

l. On 13151, press PLOT SWEEP switch to RESET and release; observe that the DIGITAL LOCATER displays all zeros.

m. On 13151, initiate a PLOT SWEEP and observe DIGITAL LOCATER. If an SD301C is being used, the display will increase in increments of 1/500 of the ANALYSIS RANGE setting (UPPER LIMIT frequency) to 499/500 of the UPPER LIMIT frequency. If a 13178 is being used, the DIGITAL LOCATER display will increase in increments of 1, from zero to 499.

n. On 13151, check operation of "joystick." Press to left, slow speed, and then further left to fast speed while observing the cursor (intensified dot on display) and the value of the DIGITAL LOCATER. Repeat this check pressing the "joystick" to the RIGHT.

o. On 13151, set UPDATE TIME switch to .05, and WATERFALL UP/DOWN toggle switch to DOWN.

p. Set MODE selector to BOTH, and WATERFALL LIN/LOG switch to LIN 128 or 64. (For either setting, the spectrogram will be 64 lines in the BOTH MODE.)

Observe the previous single sweep occupies only the bottom portion of the oscilloscope display, with a 64-line spectrogram at the top. New data lines will continue to fill the waterfall display from the top.

At this time adjust the SKEW, LINE SEPARATION, and DEFLECTION AMPLITUDE controls for the desired presentation. For example, see Figure 1-3 in Section I of this manual.

q. Press and hold in the UPDATE push button, and press and release the ERASE button. The waterfall display should change to zero-signal lines. Release the UPDATE push button and the waterfall display should resume updating.

r. On the 13151, press and release the HOLD push button; both the waterfall and single sweep displays should stop updating and be held stationary.

s. On the 13151, set WATERFALL to LIN 64; then press and release the CAPTURE/HOLD button. It will light and the display will be updated from the top until all 64 lines are updated; then updating will stop, the CAPTURE/HOLD indicator will go out, and the HOLD indicator will light.

t. On the 13151, set WATERFALL UP/DOWN toggle switch to UP.

u. Repeat Step s. and observe similar results except that the waterfall display is updated from the bottom.

v. On the 13151, set MODE selector to WATERFALL, and associated LIN/LOG switch to LIN 128. Set UPDATE TIME switch to .1, and WATERFALL UP/DOWN toggle switch to DOWN.

w. On 13151, press and release UPDATE push button. Observe 128-line spectrogram display being continuously updated from the top.

x. Repeat the waterfall operational check of Steps v. and w., but set the WATERFALL LIN/LOG switch to LOG.

This completes the operational checkout procedure.

2.3 OPERATION

Operator proficiency is best attained by studying carefully the functional descriptions of all front-panel controls and indicators given in Section I of this manual, and by performing the Operational Checkout Procedure of Paragraph 2.2. Be sure to observe the "Special Operating Consideration" of the following Paragraph 2.4.

2.4 SPECIAL OPERATING CONSIDERATIONS

2.4.1 SD301/13151 Cursor Calibration

When using a Model SD301 series RTA with the Model 13151, the following procedure should be performed to ensure calibration compatibility between the SD301 output and the 13151 DIGITAL LOCATER readings.

a. Interconnect and power the 13151, SD301, and X-Y Display units as described in Steps a. through d. of Paragraph 2.2.

b. On the SD301 RTA, set the front-panel switches as follows:

Switch	Setting
ANALYSIS RANGE	20K
FREQUENCY MARKERS	INT
CAL/OPER	SPECTRUM CAL 0
GAIN	X1
MEMORY PERIOD	AUTO
MODE	SCOPE FAST

c. Operate the 13151 in the SINGLE SWEEP, REAL TIME LIN mode.

d. Adjust the LEFT/RIGHT slewing switch for a reading of 6000 Hz on the DIGITAL LOCATER.

e. Observe the cursor intensified dot position relative to the peak of the 30% marker on the X-Y display. Adjust the FREQUENCY-CAL screwdriver adjust control on the front panel of the SD301 RTA so that the cursor dot is located at the peak of the 30% marker.

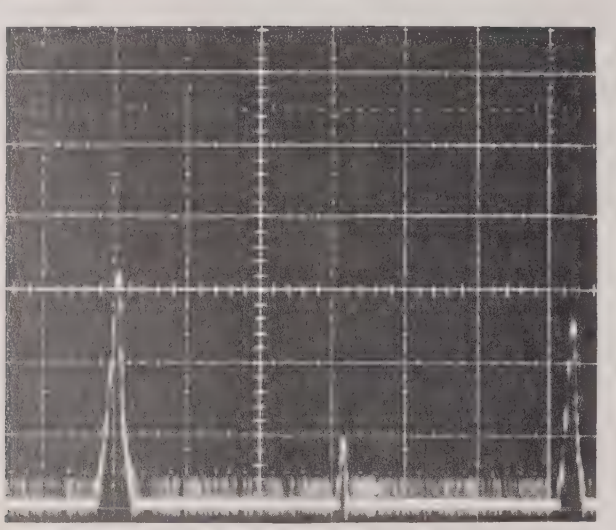


Figure 2-3A. Noisy Baseline

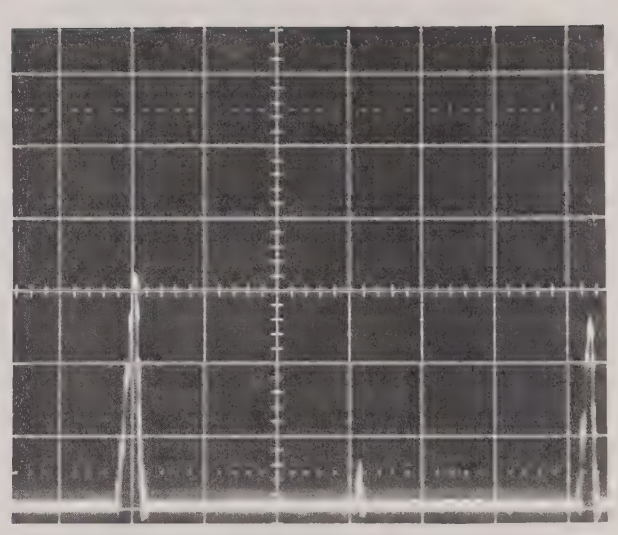


Figure 2-3B. Baseline Adjusted

2.4.2 Baseline Adjustment

If, when operating with an SD301 RTA, the baseline is similar to that shown in Figure 2-3A (the 13151 is in REAL TIME, SINGLE SWEEP, LOG mode), perform the following adjustment:

a. Remove the top cover from the 13151.

b. Remove power, use extender card and extend circuit card A27. Re-apply power.

c. Observe the X-Y display and adjust A27R1 for the best baseline, similar to that shown in Figure 2-3B.

d. Remove power, replace circuit card A27 in its receptacle, store the extender card, and replace the top cover. Re-apply power and proceed as desired.

2.4.3 Pen Lift Operation

The rear-of-chassis PEN LIFT terminals provide a set of normally-open contacts that close automatically at the end of a sweep, and open again at the start of the next sweep. Before using these terminals, observe the following "CAUTION":

CAUTION

To prevent permanent damage to the pen lift relay contacts in the 13151, be sure that a diode is properly installed across the pen lift solenoid coil in the recorder being used.

2.5 CONNECTOR FUNCTIONS

Tables 2-1 and 2-2 provide the input/output functions for each pin of rear-of-chassis connectors J18 and J19.

Table 2-1. J18 Connector Functions

PIN NO.	*FUNCTION	PIN NO.	*FUNCTION
1	2^0 Digital Input	20	
2		21	A/D Convert Enable
3	2^1 Digital Input	22	
4		23	
5	2^2 Digital Input	24	
6		25	
7	2^3 Digital Input	26	
8		27	
9	2^4 Digital Input	28	
10		29	
11	2^5 Digital Input	30	
12		31	
13	2^6 Digital Input	32	
14		33	
15	2^7 Digital Input	34	
16		35	
17	2^8 Digital Input	36	
18		37	
19	2^9 Digital Input	38	

*Pins without a "function" are SPARES.

Table 2-2. J19 Connector Functions

PIN NO.	*FUNCTION	PIN NO.	*FUNCTION
1	Ground	20	
2		21	Sense 50 Hz**
3	Sense 10 Hz**	22	Sense 500 Hz**
4	Sense 100 Hz**	23	Sense 5 kHz**
5	Sense 2 kHz**	24	Sense 20 kHz**
6	Sense 10 kHz**	25	
7		26	
8		27	
9		28	
10		29	
11		30	
12		31	
13	Sense 50 kHz**	32	
14		33	
15		34	
16		35	
17		36	Sense 1 kHz**
18		37	
19	Sense SD301 connected (GND)	38	

*Pins without a "function" are SPARES.

**SD301 ANALYSIS RANGE switch setting.

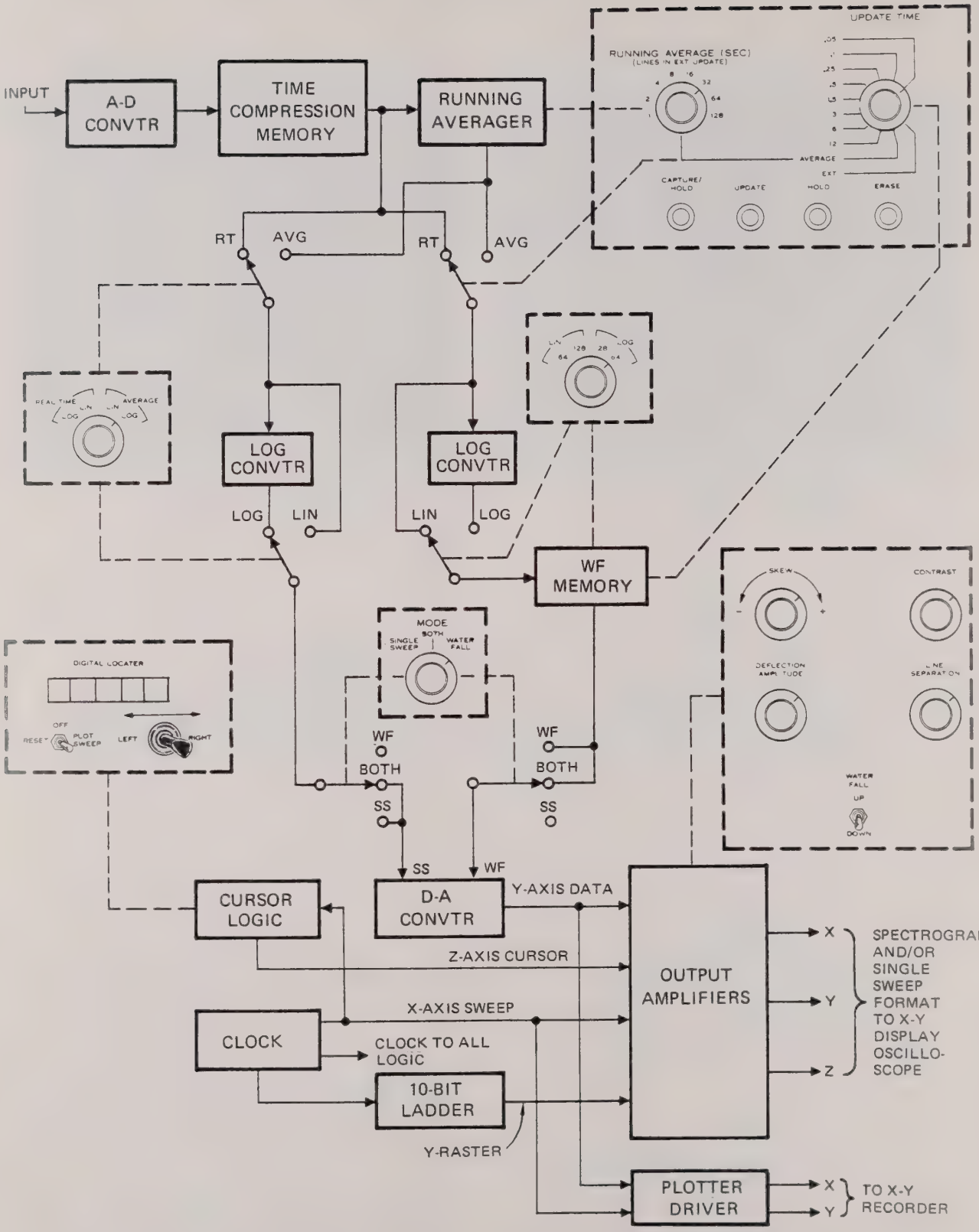


Figure 3-1. Functional Block Diagram, Model 13151

SECTION III

THEORY OF OPERATION

3.1 CONCEPT OF OPERATION

The Model 13151 formats the analog data output from instruments such as the SDC Model SD301C or 13178 into a spectrogram display for presentation on a large-screen oscilloscope such as a Model 13116-2 X-Y Display. The analog input (500-data-point ensembles) is first converted to digital form. Then all data processing such as time compression, averaging, log conversion, and formatting are performed using digital techniques. The processed and formatted data is then converted to analog form and outputed for display on an oscilloscope and/or an X-Y recorder.

The term "ensemble" normally describes a group of randomly varying time functions. Here it is used to describe a sequence of spectrum outputs from the Model SD301C (or time data samples from the 13178). One ensemble from an SD301C comprises 500 linear voltage steps; the value of each step is proportional to the sampled spectrum signal amplitude of a synthesized filter location in the Model SD301C.

The time data input from the Model 13178 is sampled (under control of the 13178) to provide 500-data-point "ensembles"; each data sample is proportional to the amplitude of the instantaneous value of the data signal applied to the 13178. (For further details on this subject, refer to the instruction manuals for the SD301C and/or the 13178.)

3.2 FUNCTIONAL DESCRIPTION (See Figure 3-1)

The input data samples are each converted to a 10-bit binary word and entered into a recirculating, time-compression register. Regardless of the rate of the input analog "steps" or "samples," 500 sequential digitized samples (one RTA sweep or ensemble) are compressed into the input memory in a space equivalent to 250 microseconds. An additional 6 microseconds are provided between ensembles to allow for oscilloscope retrace time.

As shown in Figure 3-1, the time compressed ensembles are applied to a running averager; they are also routed to the RT (Real Time) contacts of the REAL TIME/AVERAGE switch.

The running averager continuously accepts digitized data and produces an averaged data value based on the following formula:

$$\text{New average} = \text{Previous Average} + \frac{\text{New Data} - \text{Previous Average}}{N}$$

Where "N" equals the number of ensembles over which the average is taken.

To follow the data path when operating in the SS mode (SINGLE SWEEP MODE), see Figure 3-1. The REAL TIME/AVERAGE switch selects either RT LIN/LOG or AVG LIN/LOG. In RT LIN mode, the time compressed data is routed directly through to the DAC (digital-to-analog). In RT LOG mode, the time-compressed data is converted to log form before being applied to the DAC. The output of the DAC is amplified and outputed as the Y-axis data for display on an oscilloscope or X-Y recorder.

In like manner as described for the RT LIN/LOG SINGLE SWEEP modes, the averaged data from the output of the running averager can be selected in LIN or LOG form for application to the WF (waterfall) memory.

Refer again to Figure 3-1 and follow the data path for operation in any of the WF modes. A separate log converter circuit is used here that provides a 6-bit binary output. Only the 6 MSB's of the input data are used. The full 6-bit resolution is displayed (outputed) when a 64-line spectrogram is selected. For 128-line operation, only the 3 MSB's of each digital word are used.

Except for the following two conditions, all previously described functions operate the same in BOTH MODE. In BOTH MODE, the amplitude of the SS data is reduced by one-half. (See Figure 1-3 in Section I.) Furthermore, the spectrogram only contains 64 lines. Note that the WATERFALL LIN/LOG switch need not be set to 64. If it is set to 128, the 64 most recent lines of the 128 that are in the WF memory will be outputed for display.

SECTION IV
CALIBRATION AND MAINTENANCE

4.1 GENERAL

This section contains instructions for calibrating the Model 13151, except for the 10-bit and 12-bit ladder circuit cards, A3 and A30. These cards are calibrated in the unit using the Model SD35-1 Ladder Test Fixture, available only from Spectral Dynamics Corporation. An instruction manual is included with the Test Fixture, that provides the calibration procedures for the ladder circuit cards.

Before calibrating the instrument, the technician is advised to study carefully Sections I and III of this manual, especially the functional descriptions of the front-panel controls and indicators that are provided in Paragraphs 1.2 and 1.3.

Most voltage checks and adjustments can be made with the circuit cards installed. An extender card is provided to facilitate easy access to the calibration adjustments and test points on some cards. However, remove cards only when directed, and then use caution when removing and installing circuit cards on the extender.

CAUTION

1. Always be sure power is off before removing or re-installing a circuit card.
2. Because neither end of the extender card is keyed, it can be used in any card receptacle and will accept any card for extending. Therefore, be sure that the component parts on the extended card are facing the same direction as when the card is in its receptacle.

Throughout this section, adjustment controls and test points are referred to by their alphanumeric designators, preceded by the alphanumeric designator of the circuit card. For example, on circuit card A24, the reference adjust control R3 is referred to as A24R3. The adjustment controls and test points can be located by observing the markings on the circuit cards and by referring to the component layout drawings included with the schematic drawings at the rear of this manual. The location of the circuit cards, extender, power supply components, etc., are shown in Figure 4-1.

Table 4-1 lists the test equipment required for calibrating the instrument. Test equipment having equal or better performance characteristics may be substituted.

4.2 CALIBRATION

4.2.1 Preliminary Setup

a. Before applying power, check that the 115/230 switch on the instrument rear-of-chassis is set to the input line voltage, and that the proper value of fuse is installed.

b. Remove the instrument top cover.

c. Remove the 10-bit ladder card, A3, and temporarily lay it aside.

d. Remove the extender card from its storage position, and install it in receptacle XA3.

e. Apply power and allow a 10-minute warmup.

Table 4-1. Test Equipment Required

Name	Model No.	Manufacturer
Digital Voltmeter	3440A	Hewlett-Packard
Oscilloscope, Dual trace	7403N	Tektronix
Ladder Test Fixture	SD35-1	Spectral Dynamics
Real Time Analyzer	SD301 (series)	Spectral Dynamics
or Time-Gram Adaptor	13178	Spectral Dynamics
X-Y Display Oscilloscope	13116 (series)	Spectral Dynamics

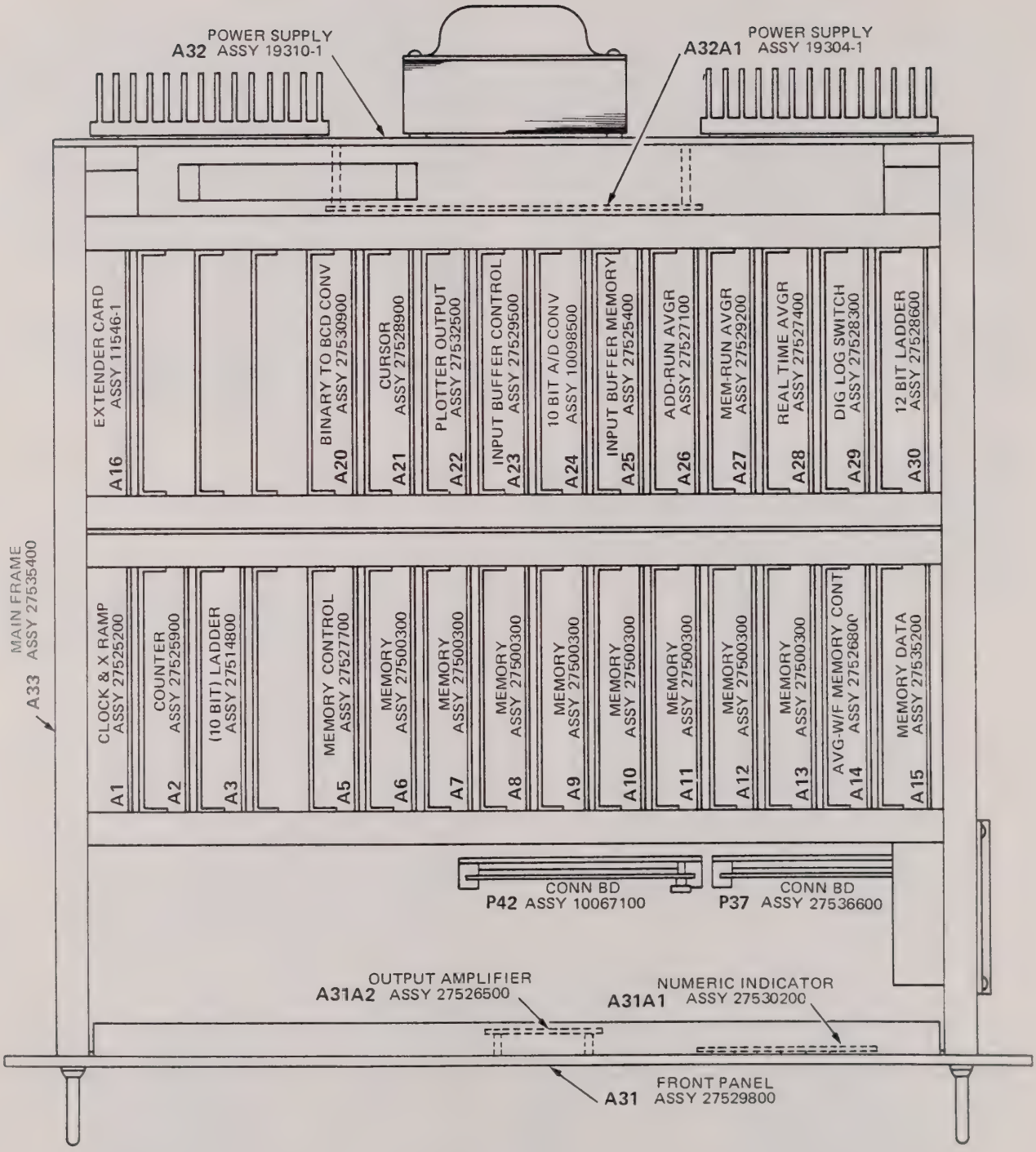

POWER SUPPLY
A32 ASSY 19310-1
POWER SUPPLY
A32A1 ASSY 19304-1
MAIN FRAME
A33 ASSY 27535400
A16 EXTENDER CARD ASSY 11546-1
A20 BINARY TO BCD CONV ASSY 27530900
A21 CURSOR ASSY 27528900
A22 PLOTTER OUTPUT ASSY 27532500
A23 INPUT BUFFER CONTROL ASSY 27529500
A24 10 BIT A/D CONV ASSY 10098500
A25 INPUT BUFFER MEMORY ASSY 27525400
A26 ADD-RUN AVGR ASSY 27527100
A27 MEM-RUN AVGR ASSY 27529200
A28 REAL TIME AVGR ASSY 27527400
A29 DIG LOG SWITCH ASSY 27528300
A30 12 BIT LADDER ASSY 27528600
A1 CLOCK & X RAMP ASSY 27525200
A2 COUNTER ASSY 27525900
A3 (10 BIT) LADDER ASSY 27514800
A5 MEMORY CONTROL ASSY 27527700
A6 MEMORY ASSY 27500300
A7 MEMORY ASSY 27500300
A8 MEMORY ASSY 27500300
A9 MEMORY ASSY 27500300
A10 MEMORY ASSY 27500300
A11 MEMORY ASSY 27500300
A12 MEMORY ASSY 27500300
A13 MEMORY ASSY 27500300
A14 AVG-W/F MEMORY CONT ASSY 27526800
A15 MEMORY DATA ASSY 27535200
CONN BD
P42 ASSY 10067100
CONN BD
P37 ASSY 27536600
OUTPUT AMPLIFIER
A31A2 ASSY 27526500
NUMERIC INDICATOR
A31A1 ASSY 27530200
FRONT PANEL
A31 ASSY 27529800

Figure 4-1. Top View (Cover Removed)

TOP VIEW OF EXTENDER CARD (FROM FRONT)

Pin No.	Voltage	Adjust	Max. Ripple (mV p-p)
B	+28V ±1.0V	A32A1R16	200
A	+12V ±0.1V	A32A1R14	100
Y	+5V ±.01V	A32A1R15	100

4.2.2 Power Supply (A32A1)

The power supply voltages are measured with a DVM at the top of the extender card installed in XA3. The voltage levels are adjusted on circuit card A32A1 as follows:

CAUTION

To prevent possible shorting of voltages and damage to the power supply, use a thin screwdriver having an insulated shaft to make the following adjustments.

Connect DVM to extender card pins B, A, and Y (in that order) and adjust the associated control for the proper voltage. See illustration and table above. Check also the ripple voltage at each pin listed in the table.

Temporarily remove power, remove the extender card from XA3, and return circuit card A3 to its receptacle, XA3. Proceed as follows.

4.2.3 Clock (A1)

a. With the power off, remove circuit card A1, insert the extender in XA1, and install A1 on top of the extender. Re-apply power.

b. Connect DVM between pins 3 and 6 of IC element U1 on A1.

c. Adjust offset potentiometer A1R13 for minimum reading on DVM, less than 10 mV.

d. Remove power, remove circuit card A1 and extender (lay extender aside temporarily), and return A1 to its receptacle.

e. Connect oscilloscope to A1TP2. Trigger oscilloscope on the negative-going signal. Observe a sawtooth ramp.

f. Adjust gain potentiometer A1R12 so that the maximum point of the ramp is 1V ±0.1V.

Proceed as follows.

4.2.4 12-Bit Ladder (A30) and 10-Bit Ladder (A3)

a. With the power off, remove the 12-bit ladder circuit card (A30).

b. Insert the Model SD35-1 Ladder Test Fixture in receptacle XA30. Install circuit card A30 on the Test Fixture and re-apply power.

c. Calibrate the 12-bit ladder as described in the Instruction Manual for Model SD35-1 Ladder Test Fixture. Note, however, that bits 11 and 12 are interchanged on this card with respect to the SD35-1. Therefore, on the SD35-1, the "LSB 12" switch is used for checking the 11th bit, and the "LSB 11" switch for the 12th bit.

d. Remove power, remove circuit card A30 and Test Fixture, and return A30 to receptacle XA30.

e. Remove 10-bit ladder A3, insert the Test Fixture in XA3, and install A3 on top of the Test Fixture. Re-apply power.

f. Connect oscilloscope to A20TP1 and check that there are no bit "dropouts" in the ramp.

g. On 13151 front panel, set the MODE switch to WATERFALL; and set associated WATERFALL switch to LIN 128.

NOTE

The 10-bit ladder (A3) is calibrated as described in the SD35-1 Manual except that the output for A3 is +9.5V to 0V (instead of 0V to -5V).

h. Remove power, remove circuit card A3 and Test Fixture, and return A3 to its receptacle, XA3. Proceed as follows. (The Test Fixture will not be required for the following procedures.)

4.2.5 A/D Converter (A24)

a. With the power off, remove circuit card A24, insert the extender card in XA24, and install A24 on the extender. Re-apply power.

NOTE

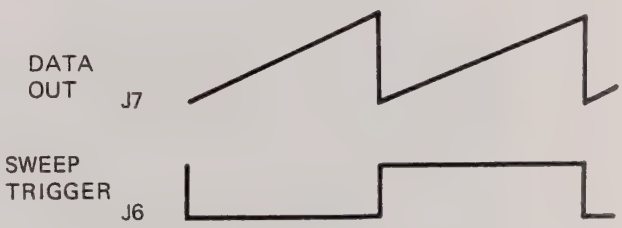
The following procedures require that a known signal be applied to the INPUT (J2) of the 13151, from either an SD301 or a Model 13178. If an SD301 is used, perform the following Step b. and then proceed to Step d. If a Model 13178 is used, proceed directly to Step c.

b. Connect the 13151, SD301, and 13116-2 as shown in Figure 4-2. Note that this setup differs from Figure 2-1 in Section II in that the INPUT (J2) of the 13151 is connected to the FREQUENCY LIN STEP (J16) output of the SD301 (instead of the SPECTRUM LIN, J2). This setup provides the proper ramp signal required to calibrate the A/D converter (A24) and later for the output amplifier (A31A2). Proceed to Step d.

c. Connect the 13151, 13178, and 13116-2 as shown in Figure 4-3. In this setup, the ramp signal at TP1 on circuit card A3 is used as the INPUT to the 13178. On the 13178, set the front-panel controls as follows:

NORM/INVERT	INVERT
AC/DC	AC
INPUT RANGE	10V
Center knob	CAL
0-BASE/BIPOLAR	BIPOLAR
SAMPLE PERIOD	33 μSEC
Center knob	CAL
DATA/EXT/LINE	DATA

The TRIGGER control is adjusted as follows: Connect the inputs of a dual-trace oscilloscope to J6 and J7. Adjust the TRIGGER control so that the negative-going side of the pulse at J6 coincides with the start of the ramp at J7 as shown below.



After all adjustments are made on the 13178, be sure that the OVERLOAD indicator is out and the TRIGGER indicator is lighted. Proceed to Step d.

d. Connect oscilloscope to output of A24U6, available at the anode of A24CR1; adjust oscilloscope to trigger automatically.

e. Observe oscilloscope and adjust A24R3 for a level of approximately -3V.

f. Connect one input (trace 1) of a dual-trace oscilloscope to A24TP1; trigger on the negative-going portion of pulse at A24TP1.

g. Connect second input (trace 2) of oscilloscope to A24TP2.

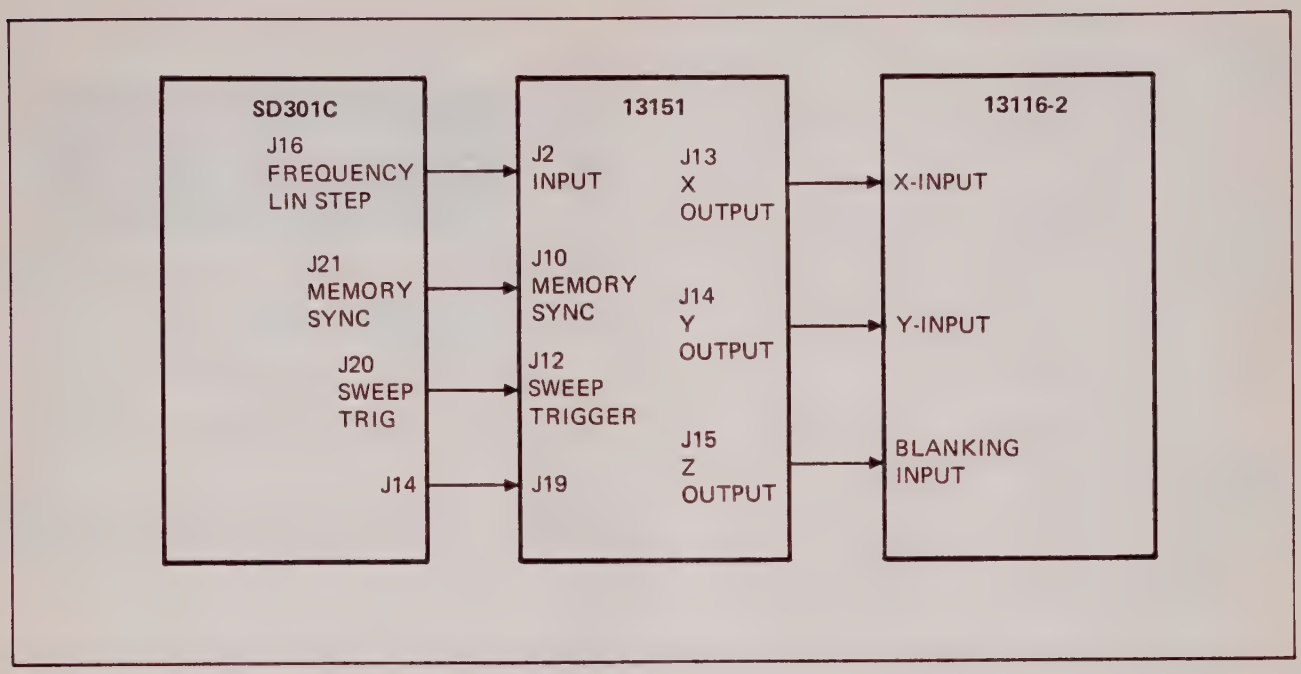


Figure 4-2. Setup for Calibration With Model SD301C Real Time Analyzer

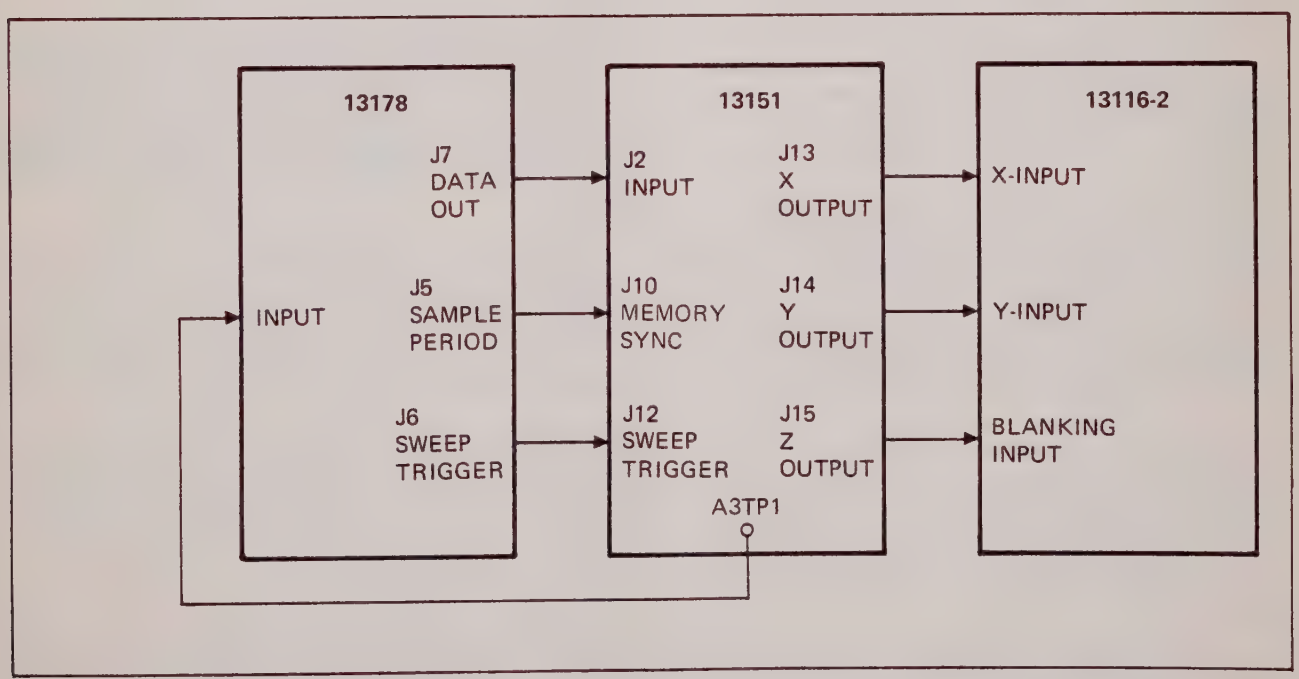


Figure 4-3. Setup for Calibration with Model 13178 Time-Gram Adaptor

h. Adjust A24R18 (full scale) fully clockwise; then turn counter-clockwise until the peak ramp value is just at its maximum (approximately +5V). (Do not exceed maximum by more than 1/2 turn of A24R18.)

i. Remove power, remove circuit card A24 and extender, and return A24 to its receptacle, XA24. Re-apply power and proceed as follows.

4.2.6 Output Amplifier (A31A2)

a. Using the same test setup as shown in Figure 4-2 (or 4-3 if applicable), set the front panel controls on the 13151 as follows:

MODE	BOTH
REAL TIME/AVERAGE	REAL TIME, LIN
DEFLECTION AMPLITUDE	Full counter-clockwise

b. Adjust the X-AXIS GAIN and OFFSET controls on the 13116-2 for a 10-inch wide display.

c. On the 13116-2, use the Y-AXIS GAIN and OFFSET controls to locate the top line of the waterfall portion of the display. Then position the top line over the top dashed line of the display graticule, just below the top solid line, and the start of the single sweep at approximately 1 inch above the bottom graticule line. See Figure 4-4.

d. Note the position of the top line of the waterfall. Adjust the LINE SEPARATION control fully clockwise. Now adjust A3R47 (10-bit ladder offset) so that the top line again sets over the top dotted line as shown in Figure 4-4.

e. Rotate the LINE SEPARATION control CCW about 45 degrees from the full CW position.

f. On circuit card A31A2, adjust A31A2R25 (single sweep offset) so that the start of the single sweep is 1 inch above the bottom graticule line. (See Figure 4-4.)

g. Now set the MODE switch to SINGLE SWEEP. The start of the single sweep should stay at the same point as in Step d. If not, alternately set the MODE switch to BOTH and SINGLE SWEEP, and adjust A31A2R25 for minimum change in position of the start of the single sweep.

h. With the MODE switch set to SINGLE SWEEP, adjust A31A2R51 (full scale linear) so that the vertical distance between the start of the sweep and the end (maximum) is 5 inches.

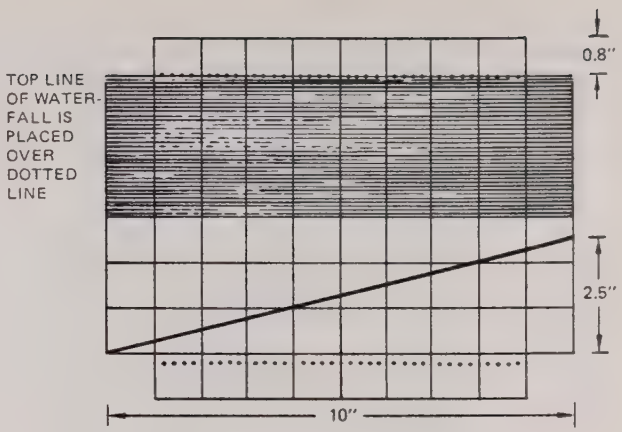


Figure 4-4. Calibration Display Example, Model 13116-2 (Zero Signal on Waterfall, Linear Ramp on Single Sweep)

i. On the 13151, set the REAL TIME/AVERAGE switch to REAL TIME LOG.

j. Adjust A31A2R55 (full scale log) for same display as Step g.

k. Alternately set the REAL TIME/AVERAGE switch to LIN and LOG; the maximum point of the displays should coincide. If not, repeat the adjustments of f. through h.

l. On the 13151, set the MODE switch to BOTH and the REAL TIME/AVERAGE switch to REAL TIME LIN.

m. Adjust A31A2R53 (1-2 full scale) so the single sweep ramp is deflected 2-1/2 inches as shown in Figure 4-4.

n. Set REAL TIME/AVERAGE switch to REAL TIME LOG.

o. Adjust A31A2R57 (1/2 full scale log) for same display as Step k. (Shown in Figure 4-4.)

p. Alternately set the REAL TIME/AVERAGE switch to LIN and LOG, and observe the size and position of the single sweep ramp. If interaction exists, shifting of ramp in size or position, repeat the adjustments of Steps j. through m.

This completes the calibration procedure. Remove power and all test equipment, replace the instrument top cover, and place instrument in service. To ensure correct overall performance, perform the Operational Checkout Procedure of Paragraph 2.2.

4.3 TROUBLESHOOTING

Unless you are just browsing through this manual, you are probably looking here for help. If help is needed, it is as close as your telephone! Or, you may want to go it alone. In either case, you will surely want to have knowledge of the symptoms of the problem, for discussion with an SDC Service Engineer over the telephone or for making your own diagnosis. If you did not experience the problem yourself, you will no doubt want to talk to the person who did, and then try some tests of your own, using the same setup if possible.

Because the 13151 acts as a link between a signal source and a display or recording instrument, first be sure that all inputs are correct, and that the display or recording device is operating properly. The following preliminary checks should be made before removing any of the instrument covers.

a. If an SD301 RTA is being used, for example, check that its outputs (LIN SPECTRUM, MEMORY SYNC, and SWEEP TRIG) are correct.

b. Feed the outputs of the RTA directly into the X-Y Display unit or recorder, and ascertain that both of these units are functioning properly.

c. Re-insert the 13151 into the setup, and evaluate the possible trouble area by using the front-panel controls on the 13151 to set up various operating modes. (Refer as necessary to the functional descriptions of the front-panel controls and indicators in Section I of this manual.)

The Technician's Troubleshooting Philosophy Flow Chart (Figure 4-5) provides a few additional ideas concerning the initial stages of troubleshooting. (We hope it may also provide a chuckle or two!)

If you decide to initiate the troubleshooting yourself, the "Successive Half-Split Troubleshooting Method" (Figure 4-5) is recommended, aided by the "Troubleshooting Tree" (Figure 4-6). To be most effective, the "Troubleshooter's Functional Block Diagram" (Figure 4-7) should be used along with the "Tree" to help isolate the trouble. Some of the signal and timing waveforms have been drawn on this diagram for a quick reference. However, Table 4-2, "Testpoint Waveforms," provides reproductions of actual photographs taken under various test conditions.

Refer also to the schematic diagrams in the rear of this manual, for voltage levels, timing relationships, etc., for the particular circuit being checked. Observe the following CAUTIONS:

CAUTIONS

1. Always be sure power is off before removing or re-installing a circuit card.

2. Because neither end of the extender card is keyed, it can be used in any card receptacle and will accept any card for extending. Therefore, be sure that the component parts on the extended card are facing the same direction as when the card was in its receptacle.

If the preceding troubleshooting aids do not reveal the problem, please contact the Customer Services Department of Spectral Dynamics Corporation. They will work with you, using all their experience, and that of the Engineering Department if necessary, to solve your problem. We haven't lost a patient yet!

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TROUBLESHOOTING ON EASY ST.

PANIC THOUGHTS

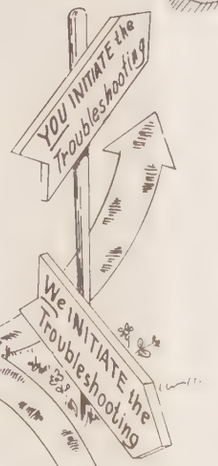
- I've never seen this one before!
- Does anybody know how it happened?
- They probably need it fixed yesterday!
- Who can I ask for help?

POSITIVE APPROACH

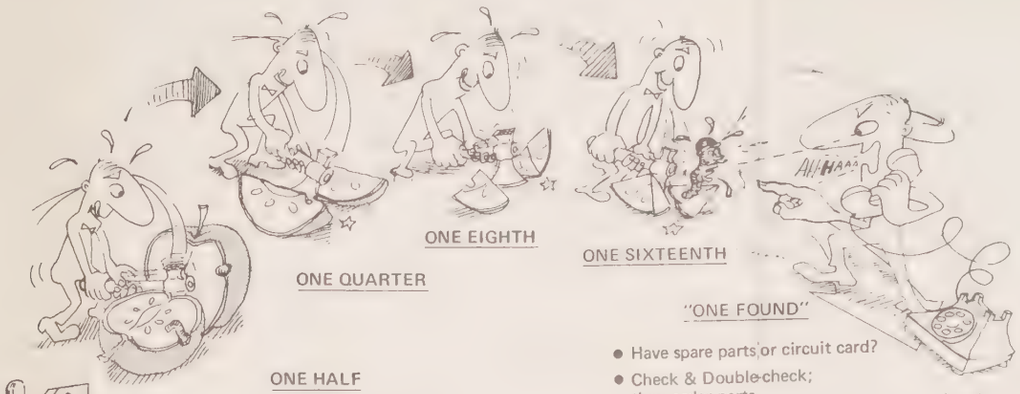
- Problem is probably simple.
- I can fix this problem easily.
- I am going to think logically.
- I am going to carefully evaluate the front panel indications.
- I'll talk to the person who had the problem.

READY

- I can whip the problem NOW.



SUCCESSIVE HALF-SPLIT TROUBLESHOOTING METHOD



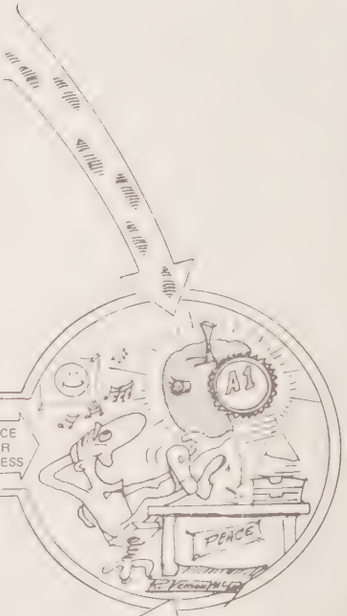
ONE HALF

- Evaluate front panel symptoms before removing cover.
- Look for obvious—simple problem.
- Do not adjust to "FIX" problems!

"ONE FOUND"

- Have spare parts or circuit card?
- Check & Double-check; then order parts.
- Prepare for call:
  Have correct part number from part or schematic.
  Have complete Model and Serial Numbers from rear of chassis.

The SDC
Customer Service Team
is
At Your Service
Aiming To Please

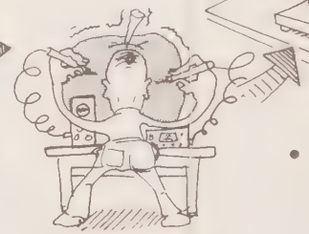


PREPARATION FOR CALL

- Have talked to person who experienced the problem.
- Have read the manual.
- Have complete Model and Serial Numbers from rear of chassis.

YOU CALL FOR INSTRUCTIONS

- We spell out tests.



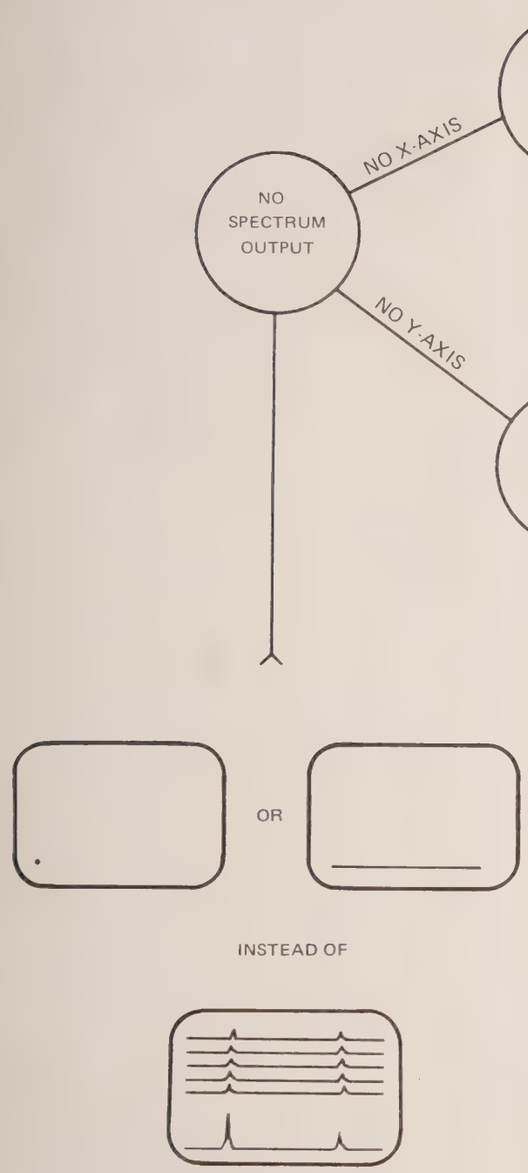
YOU PERFORM CHECKOUT

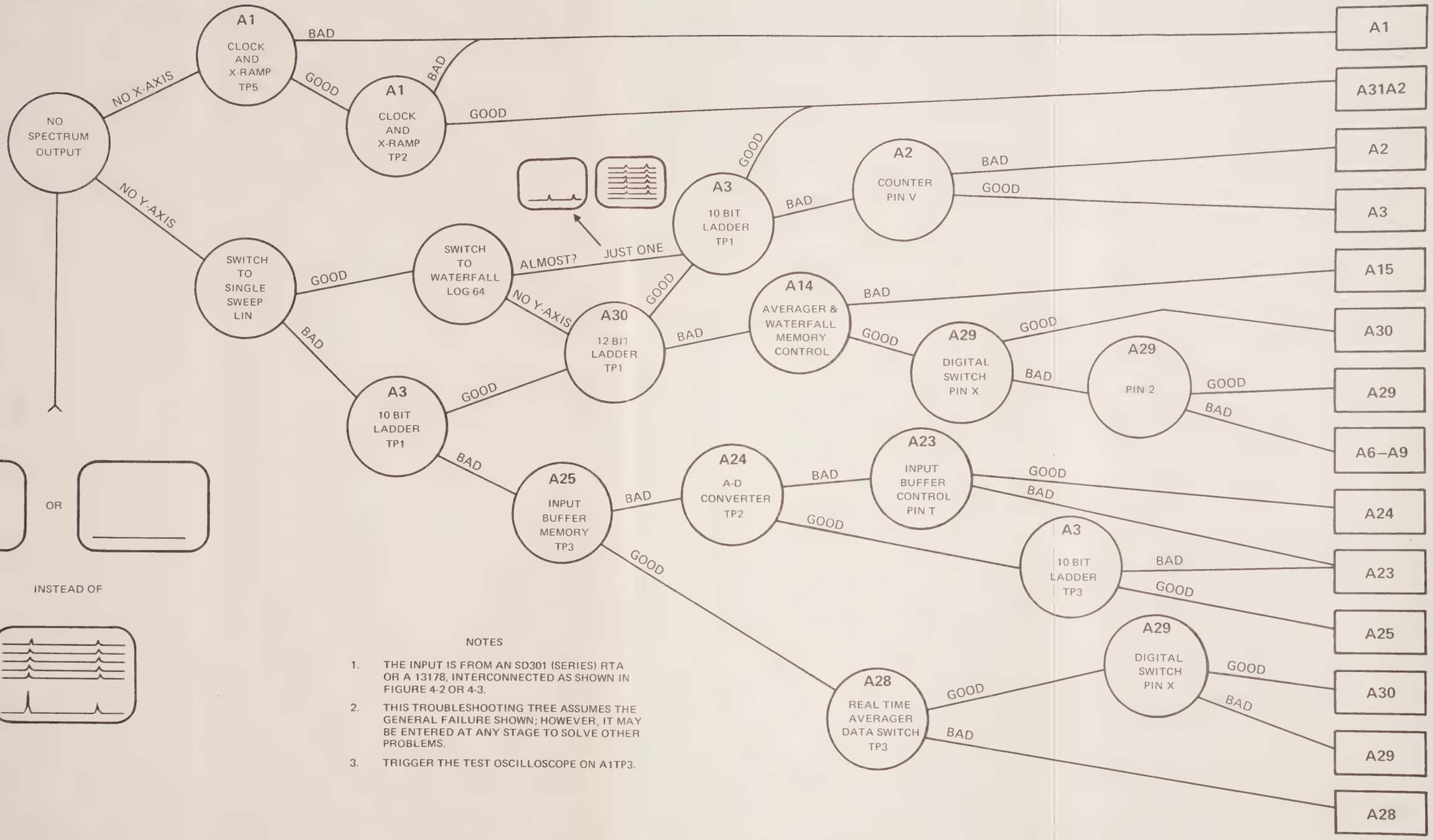
- As instructed

WE CALL BACK

- To Check & Double-check

Figure 4-5. Technicians' Troubleshooting Philosophy Flow Chart





NOTES

1. THE INPUT IS FROM AN SD301 (SERIES) RTA OR A 13178, INTERCONNECTED AS SHOWN IN FIGURE 4-2 OR 4-3.
2. THIS TROUBLESHOOTING TREE ASSUMES THE GENERAL FAILURE SHOWN; HOWEVER, IT MAY BE ENTERED AT ANY STAGE TO SOLVE OTHER PROBLEMS.
3. TRIGGER THE TEST OSCILLOSCOPE ON A1TP3.

Figure 4-6. Troubleshooting Tree

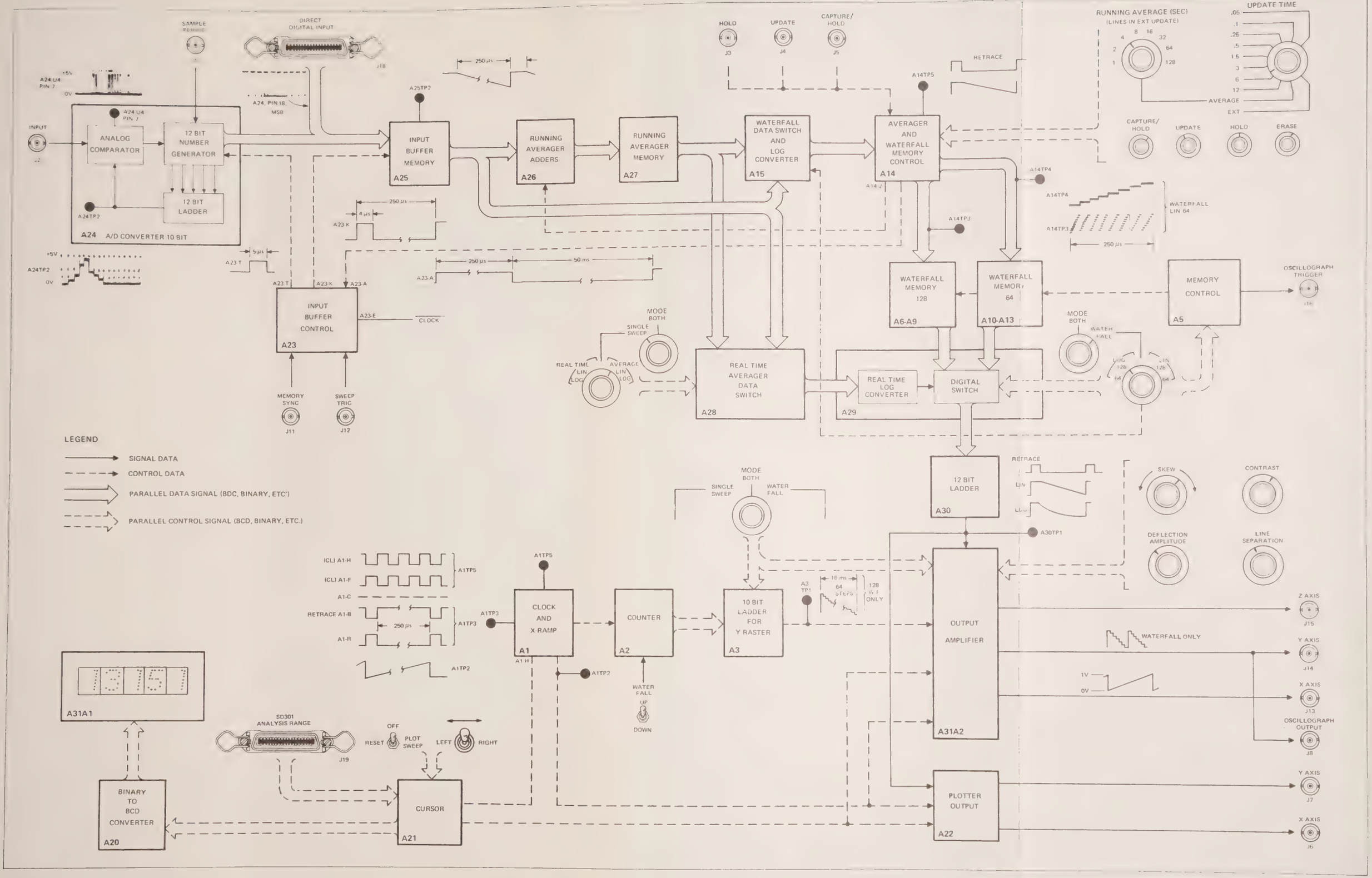


Figure 4-7. Troubleshooter's Functional Block Diagram

Table 4-2. Test Point Waveforms

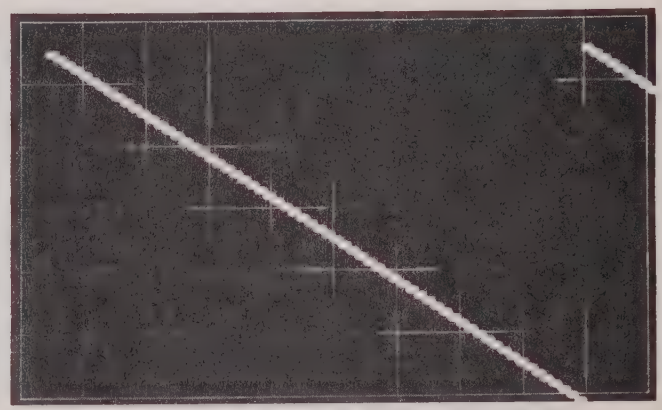
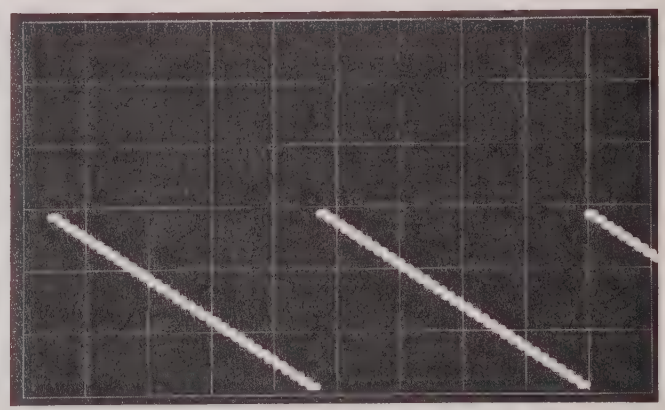
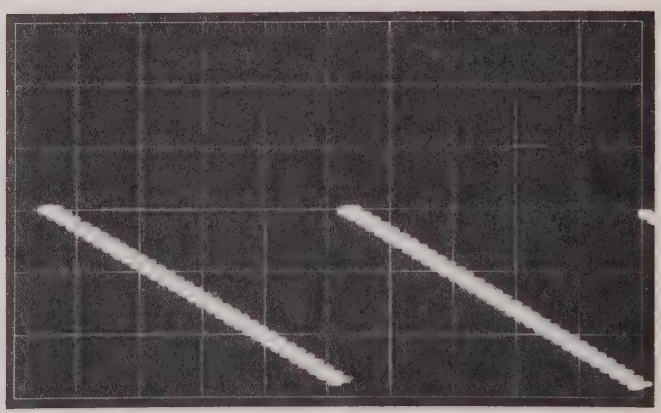
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
NOT REQUIRED	WATER FALL LIN 128	A1TP1	 SCOPE SWEEP: 2 ms TRIG: A1TP2 VERT SENS: 2V/cm
NOT REQUIRED	WATERFALL LIN 64	A1TP1	 SCOPE SWEEP: 2 ms TRIG: A1TP2 VERT SENS: 2V/cm
NOT REQUIRED	WATERFALL LIN 64	A3TP1	 SCOPE SWEEP: 2 ms TRIG: A1TP2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

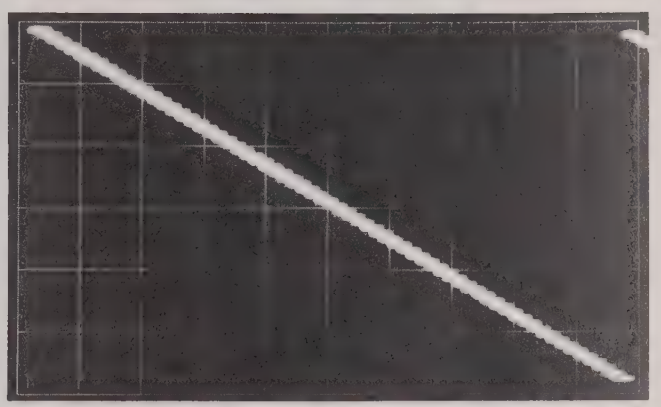
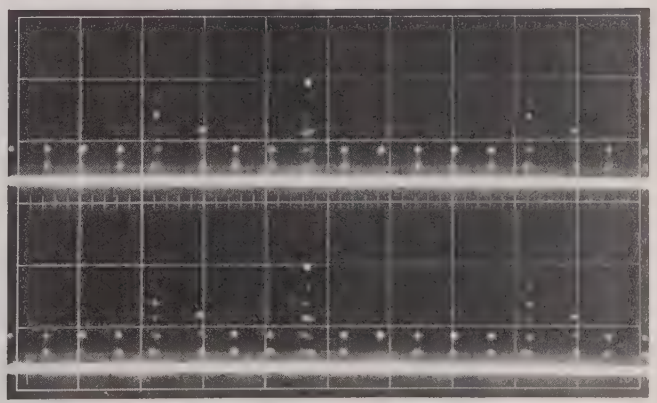
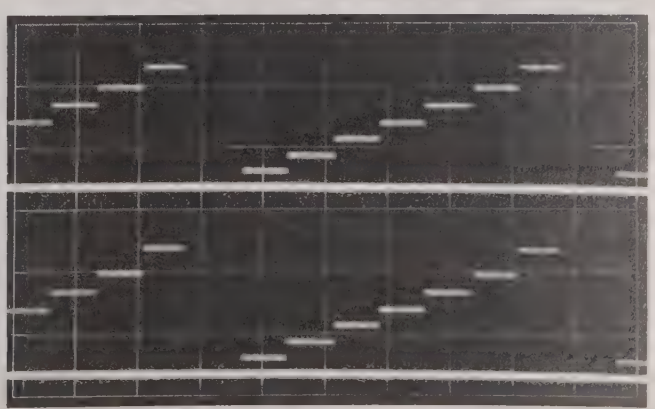
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
NOT REQUIRED	WATERFALL LIN 128	A3TP1	 SCOPE SWEEP: 2 ms TRIG: A1TP2 VERT SENS: 2V/cm
SD301 SPECTRUM LIN	WATERFALL LOG 128	A6-A13TP1 A6-A13TP2	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	WATERFALL LIN 128	A6-A13TP1 A6-A13TP2	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

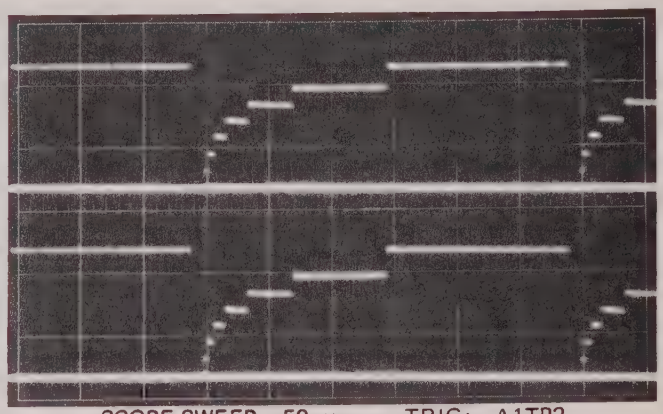
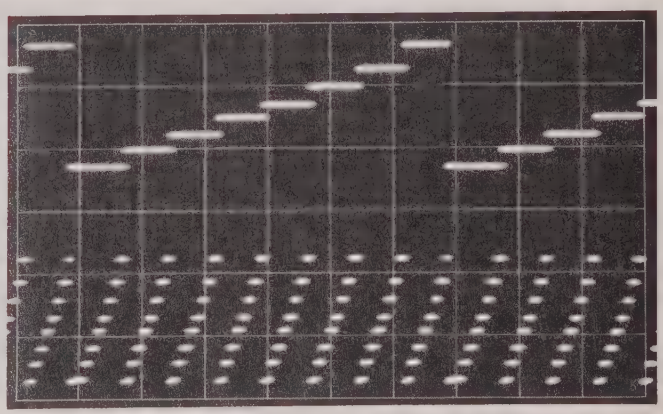
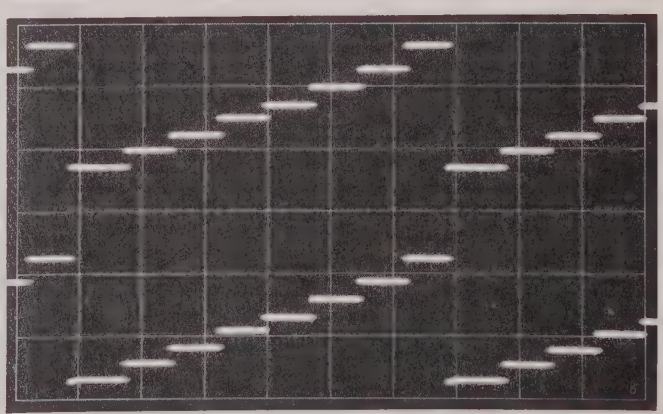
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 FREQUENCY LIN	WATERFALL LOG 128	A6-A13TP1 A6-A13TP2	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	WATERFALL LIN 64	A14TP4 A14TP3	 SCOPE SWEEP: 0.5 ms TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	WATERFALL LIN 128	A14TP4 A14TP3	 SCOPE SWEEP: 0.5 ms TRIG: A1TP2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

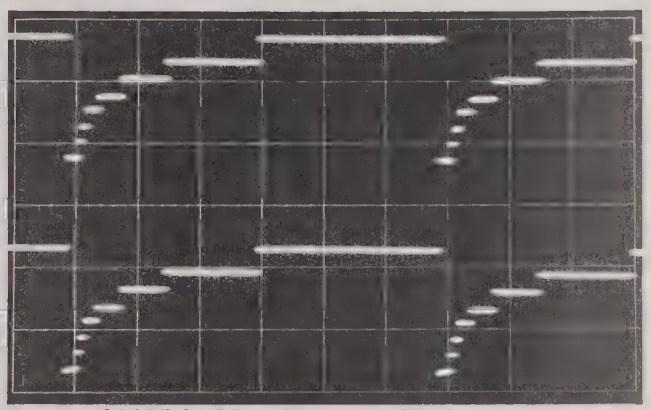
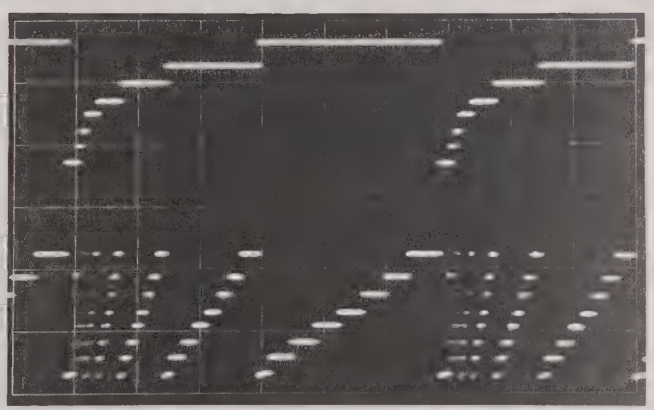
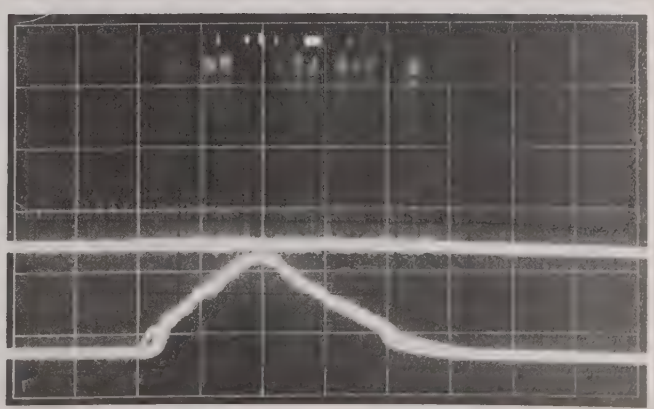
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 FREQUENCY LIN	WATERFALL LOG 128	A14TP4 A14TP3	 SCOPE SWEEP: 0.5 ms TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	WATERFALL LOG 64	A14TP4 A14TP3	 SCOPE SWEEP: 0.5 ms TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	SINGLE SWEEP REAL TIME LIN	A24, U4-7 INPUT J2	 SCOPE SWEEP: 5 ms TRIG: J2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

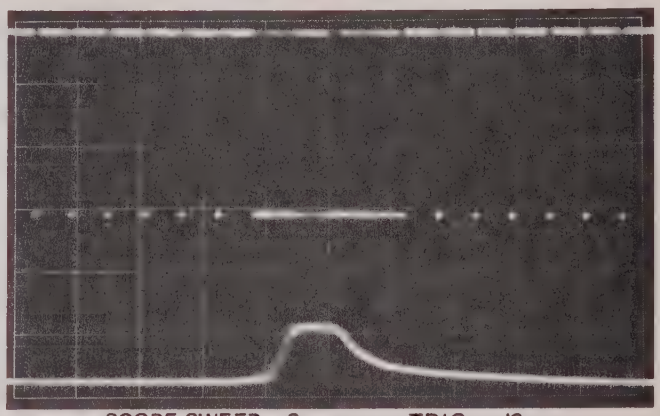
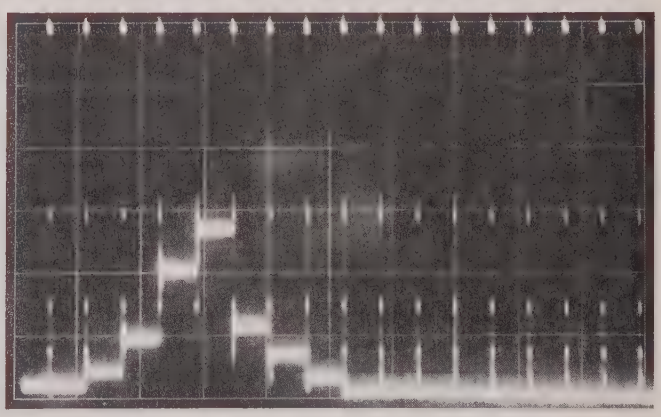
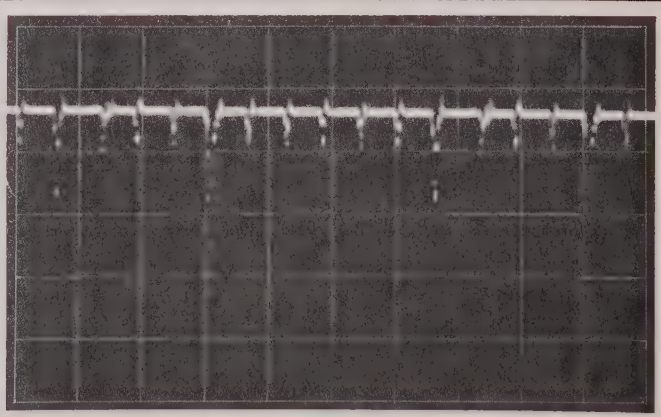
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 FREQUENCY LIN	SINGLE SWEEP REAL TIME LIN	A24, PIN 18 INPUT (J2)	 SCOPE SWEEP: 2 ms TRIG: J2 VERT SENS: 2V/cm
SD301 SPECTRUM LIN	SINGLE SWEEP REAL TIME LIN	A24TP2	 SCOPE SWEEP: 2 ms TRIG: A1TP2 VERT SENS: 5V/cm
SD301 SPECTRUM LIN	SINGLE SWEEP REAL TIME LIN	A25TP3	 SCOPE SWEEP: 0.5 ms TRIG: A1TP2 VERT SENS: 1V/cm

Table 4-2. Test Point Waveforms (Cont'd)

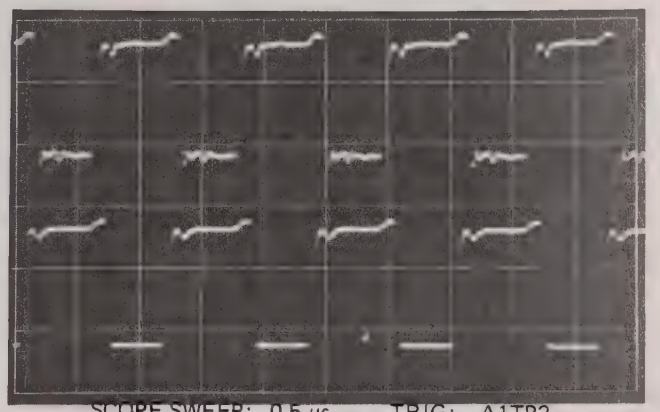
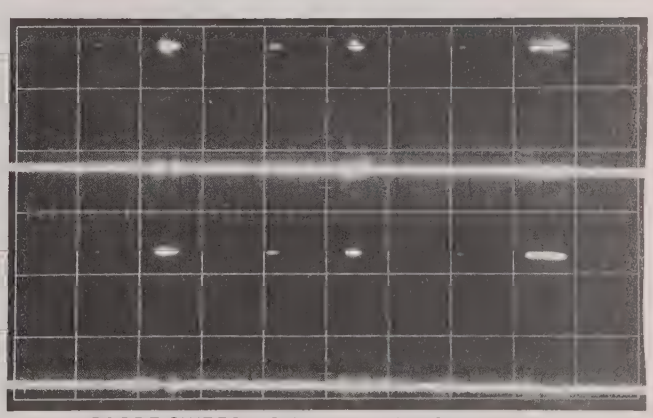
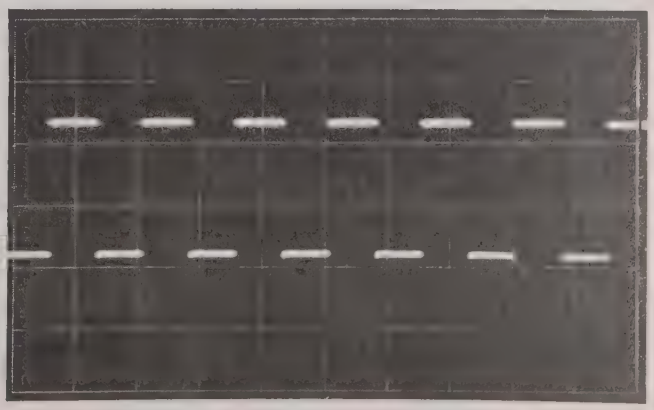
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 SPECTRUM LIN	SINGLE SWEEP AVERAGE LIN	A25TP1 A25TP2	 SCOPE SWEEP: 0.5 μs TRIG: A1TP2 VERT SENS: 10V/cm
SD301 SPECTRUM LIN	SINGLE SWEEP AVERAGE LIN	A26TP5 A26TP4	 SCOPE SWEEP: 0.1 ms TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	SINGLE SWEEP AVERAGE LIN	A27TP7	 SCOPE SWEEP: 0.2 ms TRIG: A1TP2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

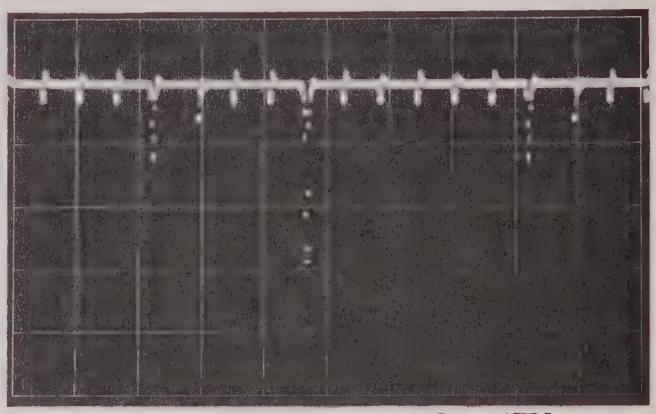
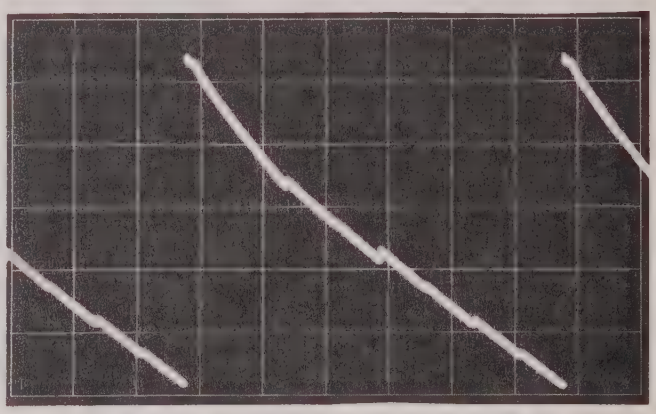
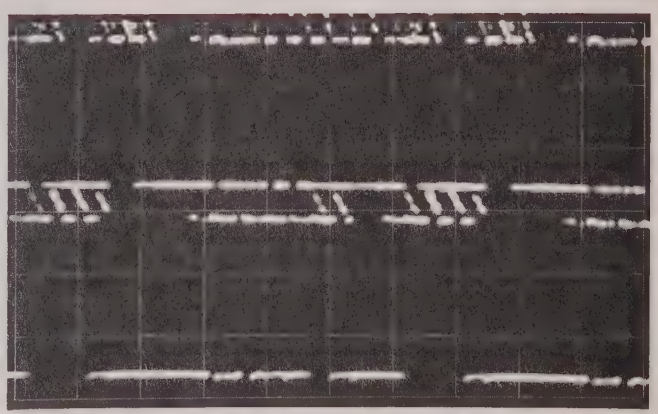
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 SPECTRUM LIN	SINGLE SWEEP REAL TIME LIN	A28TP13	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 1V/cm
SD301 FREQUENCY LIN	SINGLE SWEEP REAL TIME LIN	A28TP13	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 1V/cm
SD301 FREQUENCY LIN	SINGLE SWEEP REAL TIME LOG	A29, PIN R A29, PIN T	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm

Table 4-2. Test Point Waveforms (Cont'd)

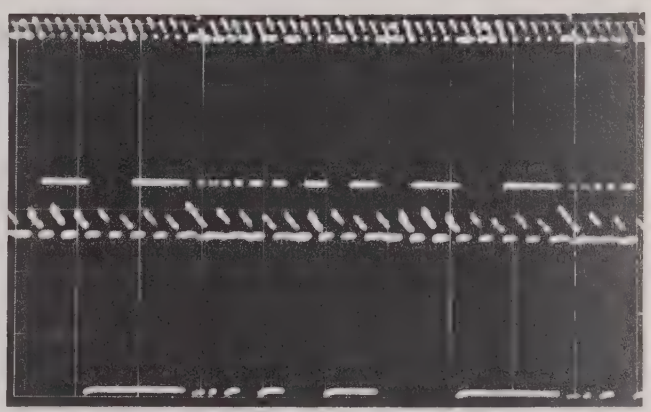
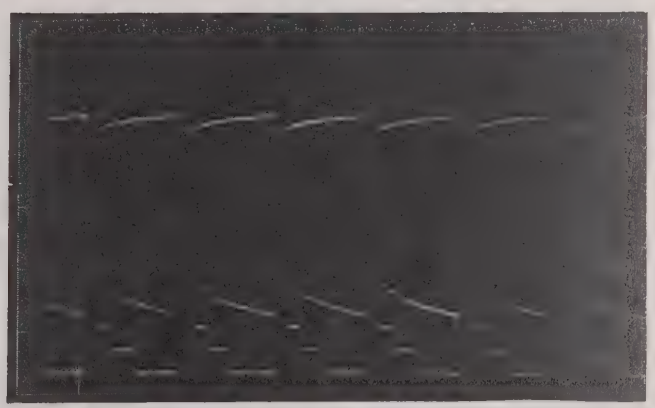
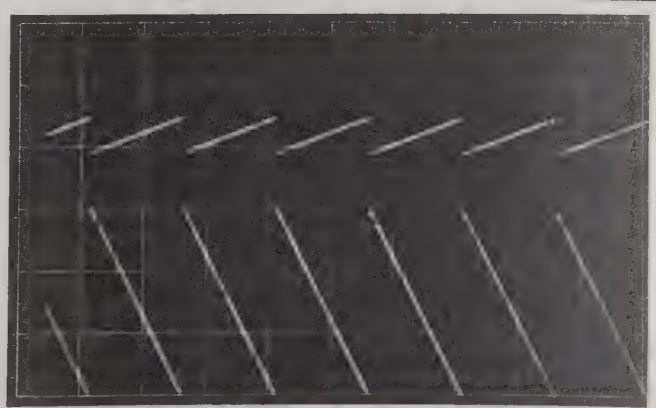
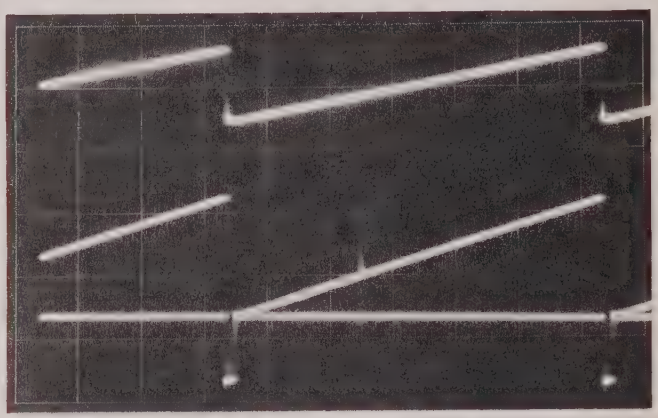
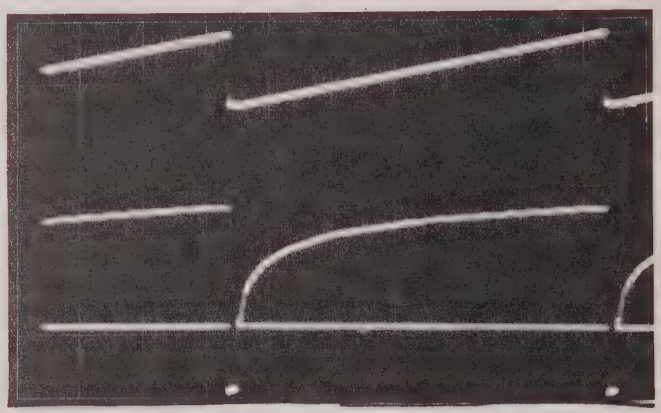
TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 FREQUENCY LIN	BOTH SS RT LOG WF LOG 64	A29-R A29-T	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm
SD301 FREQUENCY LIN	BOTH SS RT LOG WF LOG 64	A31A2TP4 A31A2TP1	 SCOPE SWEEP: 0.2 ms TRIG: A1TP2 VERT SENS: 1V/cm (Top), 2V/cm (Bot)
SD301 FREQUENCY LIN	BOTH SS RT LIN WF LIN 64	A31A2TP4 A31A2TP1	 SCOPE SWEEP: 0.2 ms TRIG: A1TP2 VERT SENS: 1V/cm (Top), 2V/cm (Bot)

Table 4-2. Test Point Waveforms (Cont'd)

TEST CONDITIONS		TEST POINT	WAVEFORM
INPUT, J2	MODE		
SD301 FREQUENCY LIN	BOTH SS RT LIN WF LIN 64	A31A2TP6 A31A2TP5	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm (Top), 1V/cm (Bot)
SD301 FREQUENCY LIN	BOTH SS RT LOG WF LOG 64	A31A2TP6 A31A2TP5	 SCOPE SWEEP: 50 μs TRIG: A1TP2 VERT SENS: 2V/cm (Top), 1V/cm (Bot)

4.4 PARTS REPLACEMENT

Except for some special SDC specification-controlled parts listed in Table 4-3, which must be ordered from Spectral Dynamics Corporation, standard electronics parts have been used throughout the instrument. Although standard, the pilot lamps and certain switches have been included to aid in their replacement. Spectral Dynamics Corporation maintains a complete stock of all parts and circuit card assemblies used in the instrument; refer to Table 4-3.

When ordering a replacement part or assembly, be sure to include the reference designation or manufacturer's designation, and a complete description. Include also the instrument name and complete model and serial numbers found on the rear of the chassis.

Table 4-3. Special Replaceable Parts List

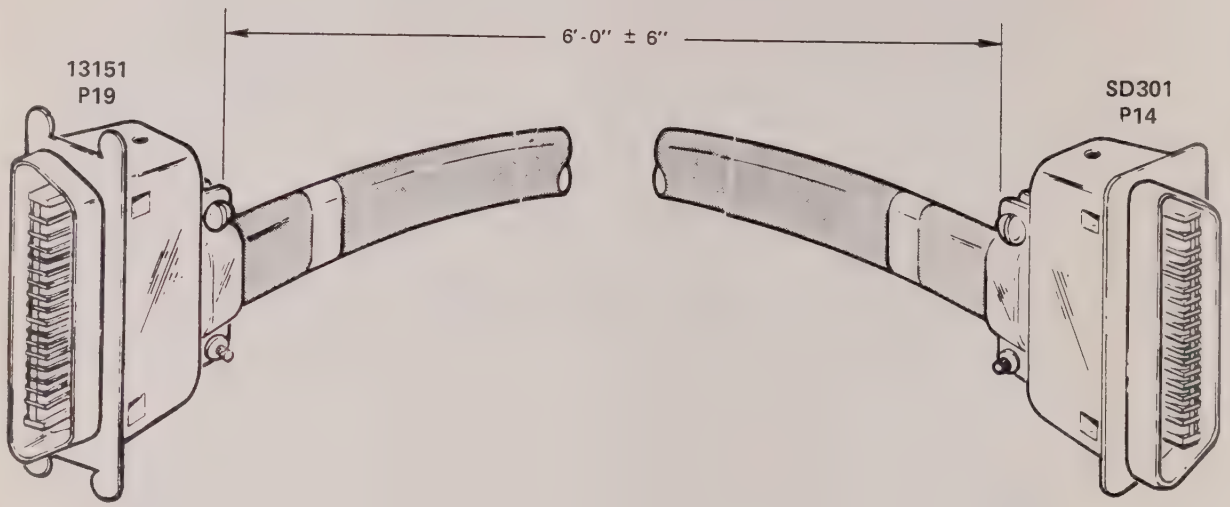
Reference Designator	Description	Part Number/ Mfr. Designation
A1	Circuit Card, Clock and X Ramp	27525200
A2	Circuit Card, Counter	27525900
A3	Circuit Card, Ladder (10 bit)	27514800
A5	Circuit Card, Memory Control	27527700
A6–A13	Circuit Card, Memory	27500300
A14	Circuit Card, Avgr–W/F Memory Control	27526800
A15	Circuit Card, Memory Data	27535200
A16	Circuit Card, Extender	11546-1
A20	Circuit Card, Binary to BCD Converter	27530900
A21	Circuit Card, Cursor	27528900
A22	Circuit Card, Plotter Output	27532500
A23	Circuit Card, Input Buffer Control	27529500
A24	Circuit Card, 10-Bit A/D Converter	10098500
A25	Circuit Card, Input Buffer Memory	27525400
A26	Circuit Card, Adder–Running Avgr	27527100
A27	Circuit Card, Memory–Running Avgr	27529200
A28	Circuit Card, Real Time Avgr	27527400
A29	Circuit Card, Digital Log Switch	27528300
A30	Circuit Card, 12-Bit Ladder	27528600
A31A1	Circuit Card, Numeric Indicator	27530200
A31A2	Circuit Card, Output Amplifier	27526500
A32A1	Circuit Card, Power Supply	19304-1
A32T1	Power Transformer	20013-501
A31DS2 -DS5	Bulb, Lamp, Indicator	345 (Chicago Miniature or G.E.)
S1	Switch	27537500
DS1	Bulb, Lamp, POWER Indicator	A1H (Chicago Min. or G.E.)
A31S5	Switch, Push Button, ERASE	27537400
A31S6	Switch, MODE (SS, BOTH, WF)	27531300
A31S7	Switch, REAL TIME/AVERAGE (SS)	27532300
A31S8	Switch, LIN 64–128/LOG 64–128	27532400
A31S9	Switch, RUNNING AVERAGE	27532200
A31S10	Switch, UPDATE TIME	27532100
A31S12	Switch, LEFT/RIGHT (Slewing)	27537300
	Knob (all)	20013-175
	Fuse, Power, 2-1/2A SLO, 3AG	Buss Littlefuse
	Power Cord	17258-S (Belden)

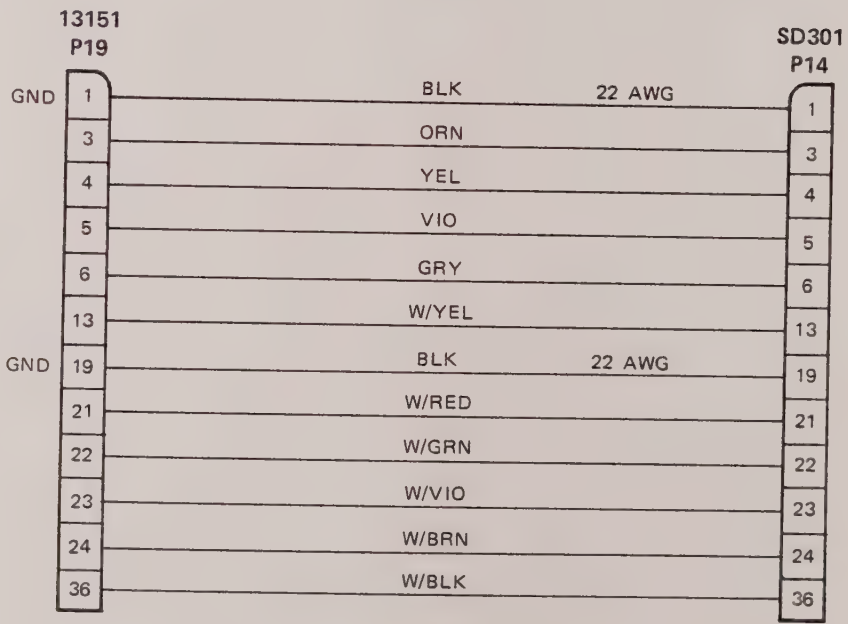
APPENDIX A

CABLE DIAGRAMS

TABLE OF CONTENTS

Figure		Page
A-1.	Model 13151/SD301 Cable Assembly No. 27536400	A-2

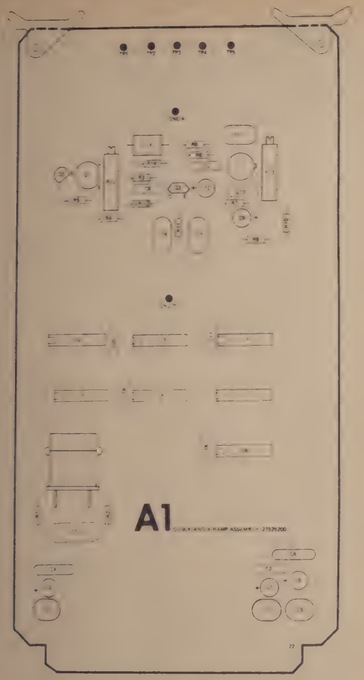


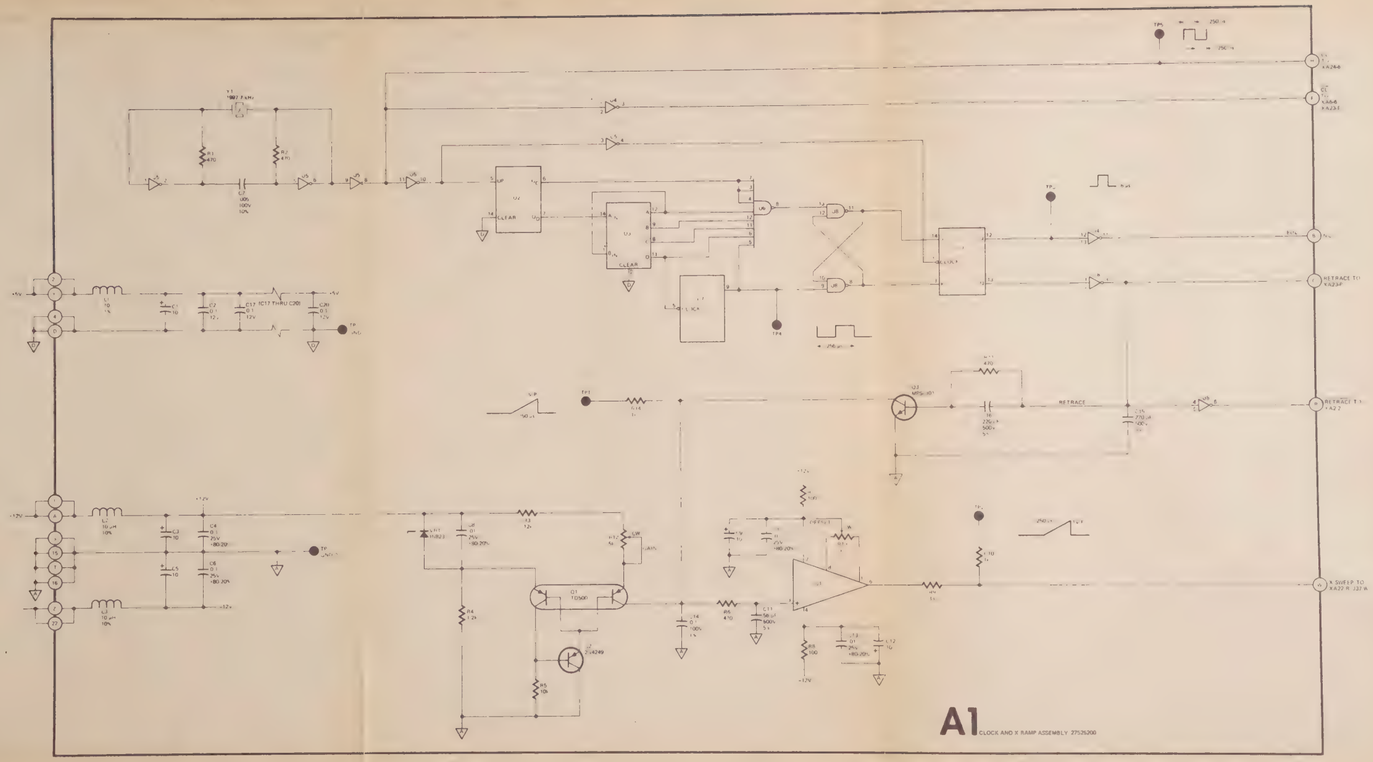


13151 (P19) 57-30362
SD301 (P14) 57-30362

UNLESS OTHERWISE SPECIFIED, ALL WIRES ARE 24 AWG.

Figure A-1. Model 13151/SD301 Cable Assembly No. 27536400





REVISIONS						
A		DIT	REDRAWN			A

NOTES: UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS.
   (b) RESISTORS ARE 1/4W, ±5%.
2. (c) CAPACITANCE SHOWN IN MICROFARADS.
   (d) CAPACITORS @ 20V, ± 20%.

INTEGRATED CIRCUITS				
REF DESIG.	PART No.	PIN POS. GND	PIN POS. VCC	OTHER CONNECTIONS
U1	SN74123N	8	16	
U2	SN-MUX	12	5	
U3	SN74107N		14	(PIN 4 NC)
U4	SN74S04N		14	(PIN 7 NC)
U5	SN74L00N		14	
U6	SN74123N		16	
U7	SN74S74N		14	
U8	SN74S00N		14	

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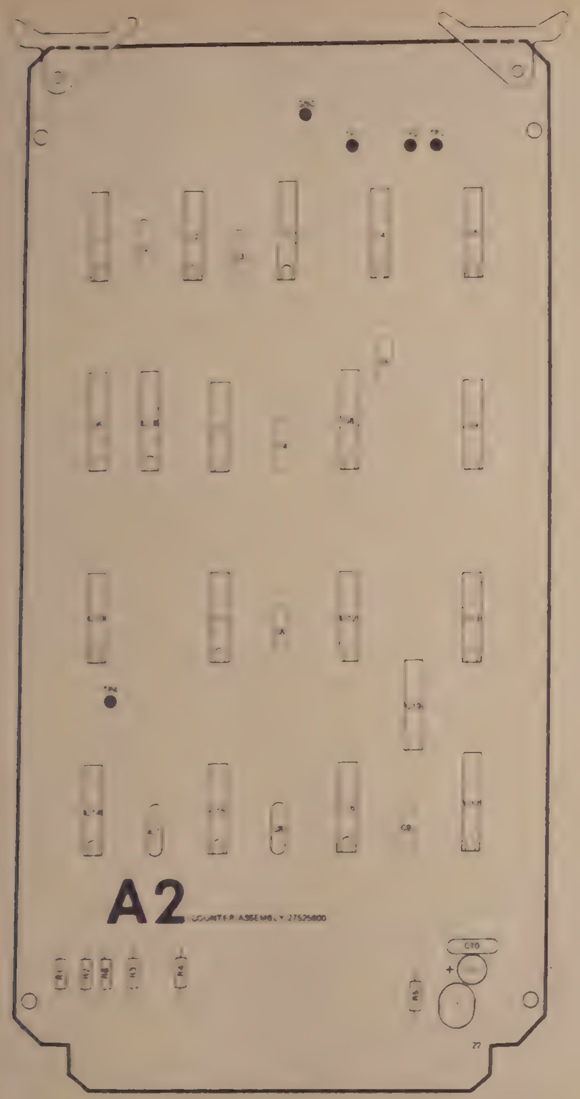
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

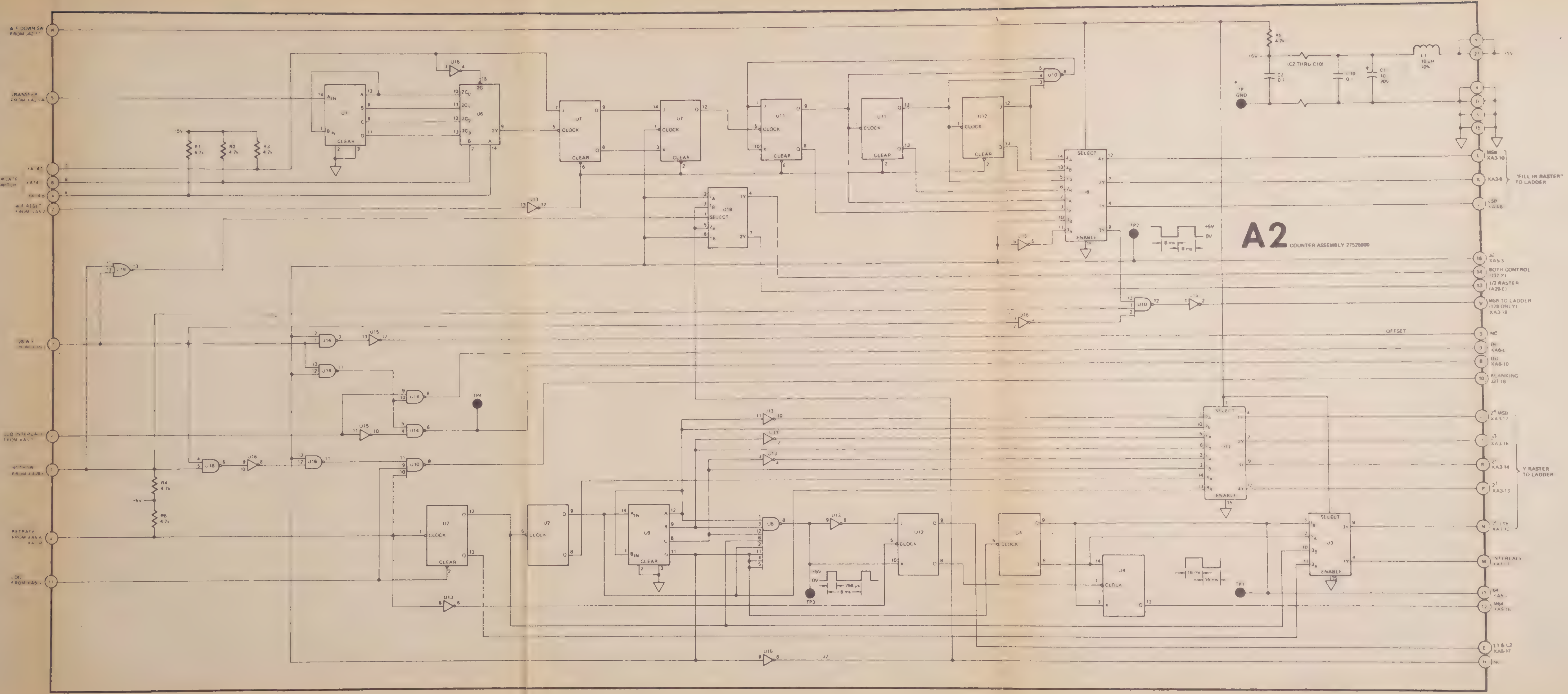
DRAWN	TP HEAST	3/73
DESIGNED		
CHECKED		
ENGINEER		
APPROVED		

TITLE: SCHEMATIC/COMPONENT LAYOUT CLOCK AND X RAMP ASSEMBLY 27525200 A1

MODEL	SIZE	DRAWING NO.	REV.
13151		27525000	A

SCALE | SHEET 1 OF 1





REVISIONS						
A		011	REDRAWN	L S 3-73		

NOTES UNLESS OTHERWISE INDICATED

1 (a) RESISTANCE SHOWN IN OHMS.

(b) RESISTORS ARE 1/4W ±5%

(c) CAPACITANCE SHOWN IN MICROFARADS.

(d) CAPACITORS @ 12V ±20%

INTEGRATED CIRCUITS

REF. DESIG.	PART NO.	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1 & U9	SN7493N	10	5	NONE
U2, U4, U7, U11 & U12	SN7473N	11	4	NONE
U3, U8, U17, & U18	SN74157N	8	16	NONE
U5	SN7430N	7	14	NONE
U6	SN74153N	8	16	NONE
U10	SN7410N	7	14	NONE
U13 & U15	SN7404N	7	14	NONE
U14 & U16	SN7400N	7	14	NONE
U19	SN7402N	7	14	U19A B & C

HIGHEST REF DESIG USED
C10
L1
R6
TP4
U19

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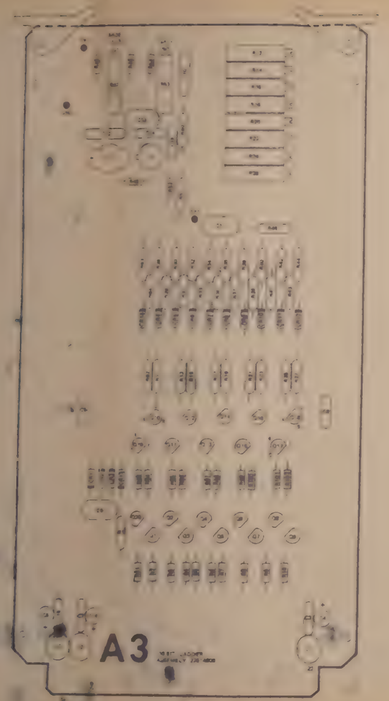
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

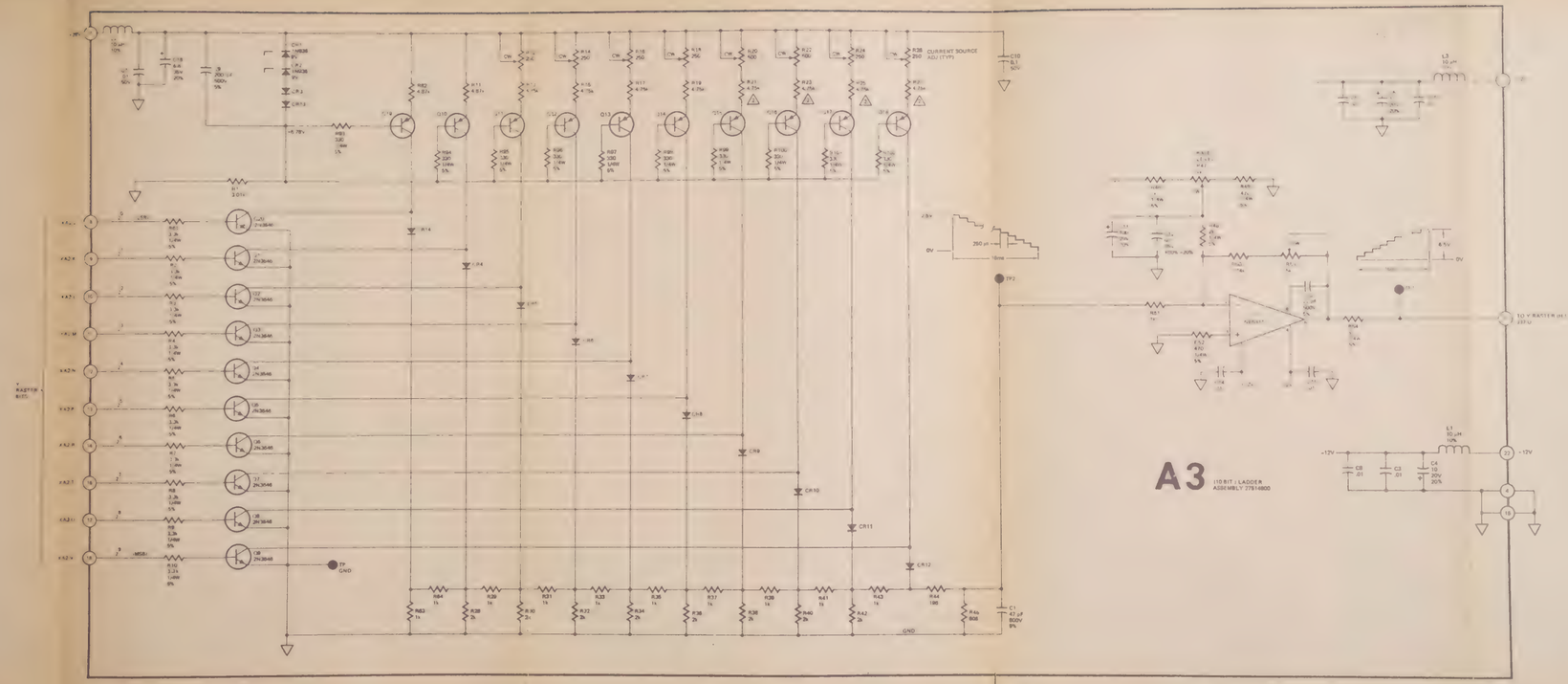
TITLE: SCHEMATIC/COMPONENT LAYOUT COUNTER ASSEMBLY 27525900 — A2

DRAWN	L SAUER	3-73
DESIGNER		
CHECKED	[illegible]	[illegible]
ENGINEER	[illegible]	[illegible]
APPROVED	[illegible]	[illegible]

MODEL	SIZE	DRAWING NO	REV
13151		27526000	A

SCALE — SHEET [illegible]





REVISIONS						
LTR	ECN					
A		0151	REDRAWN			
B	13151	151	DRAWING #			
C	13151	1514	SIG AT TP1 WAS "APPROX 10V"			
D	13151	1540	R48 WAS 200Ω ADDED 0V BASE LINE & 3.3V PEAK AT TP2 ADDED 0V BASELINE AT TP1			

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS.
(b) RESISTORS ARE 1/8W 1%.
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS @ 25 µf, 25V ARE +80% -20%
△ FACTORY ADJUST WITH TYPICAL VALUE SHOWN
3. DIODES ARE TYPE IN914.
4. TRANSISTORS ARE TYPE 1N4249

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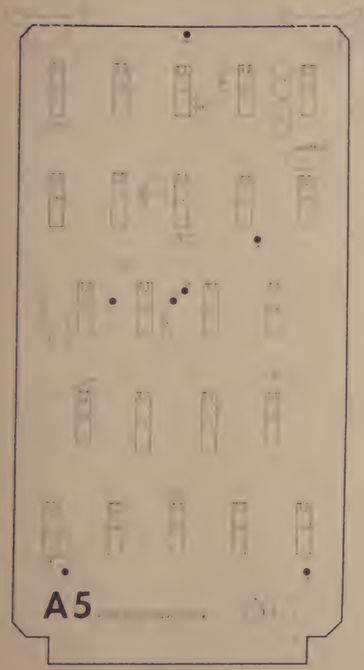
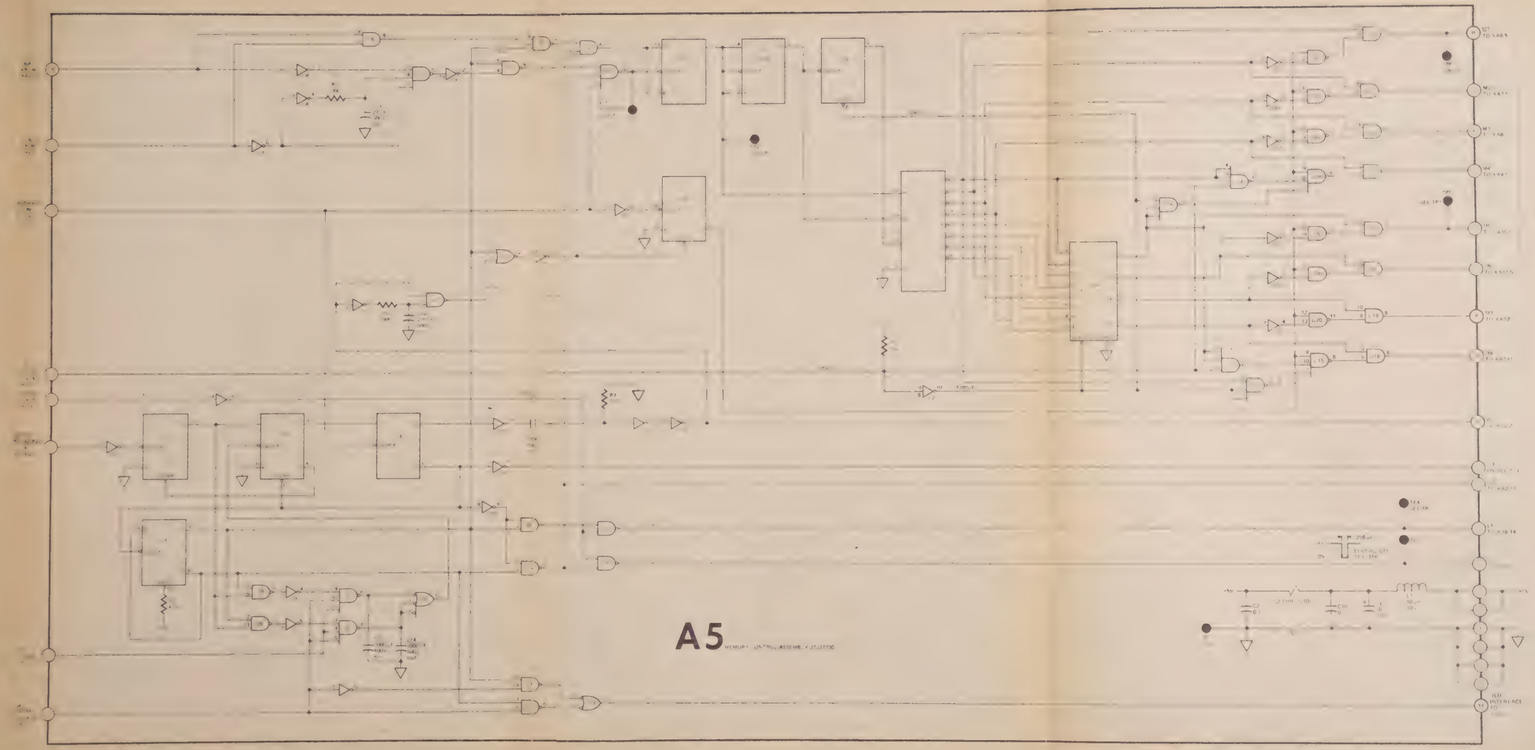
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

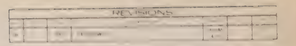
TITLE: SCHEMATIC/COMPONENT LAYOUT (10 BIT) LADDER ASSEMBLY 27514800 A3

DRAWN	8/18/1207	A3
DESIGNED		
CHECKED		
ENGINEER		
APPROVED		

MODEL	SIZE	DRAWING NO.	REV
13151		27526300	E
SCALE		SHEET 1 OF 1	

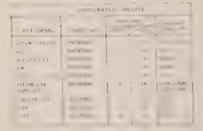






NOTES: UNLESS OTHERWISE INDICATED

1. ALL RESISTANCE SHOWN IN OHMS.
2. ALL RESISTORS ARE 1/4 W, 5%.
3. ALL CAPACITANCE SHOWN IN MICROFARADS.
4. ALL CAPACITORS ARE 50V, 20%.



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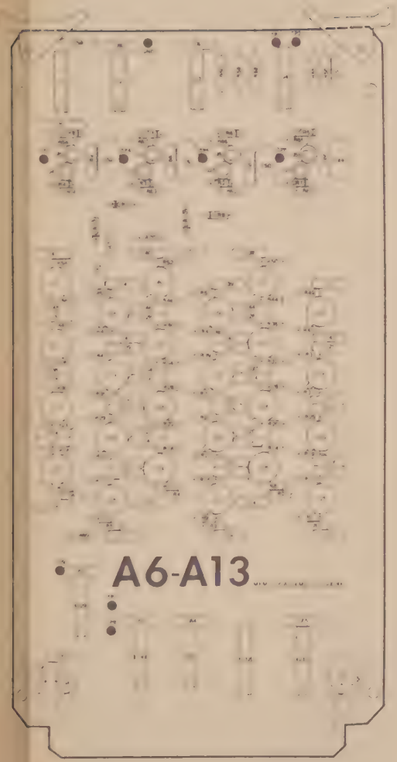
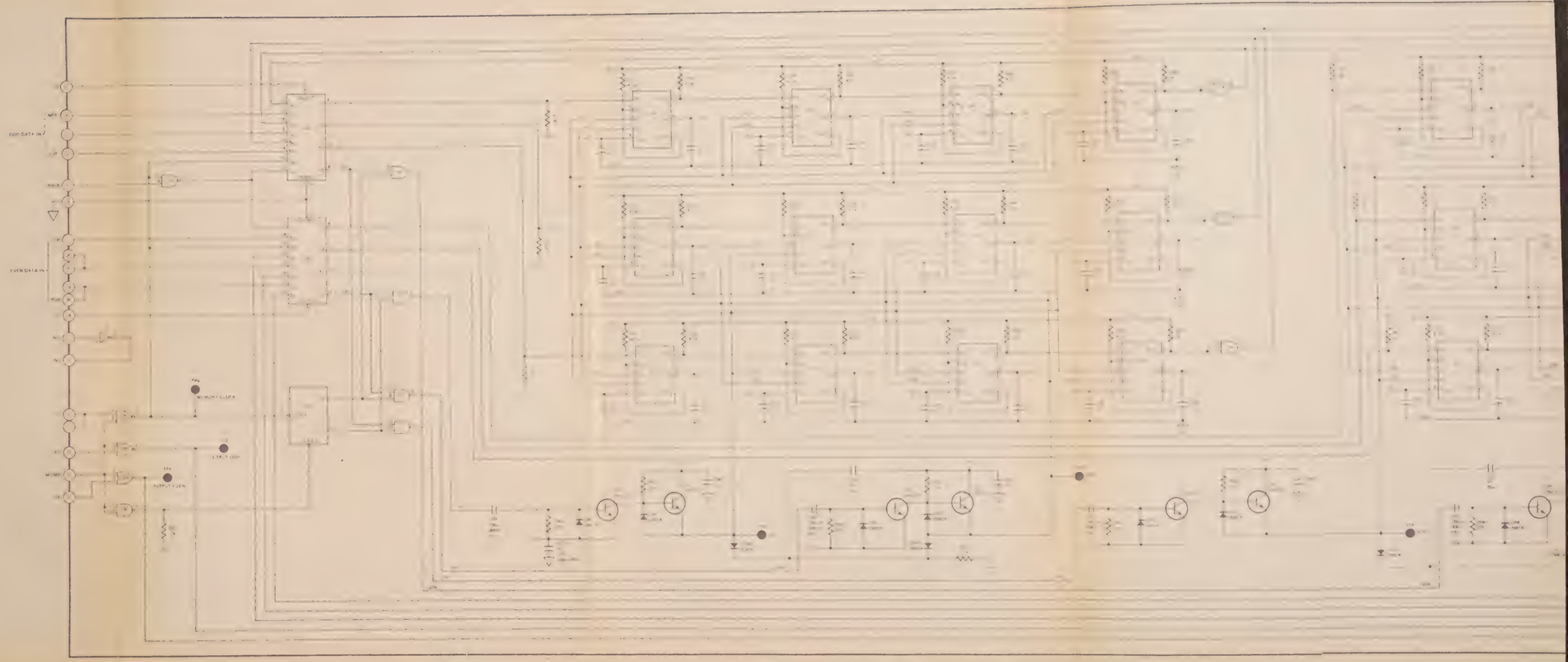
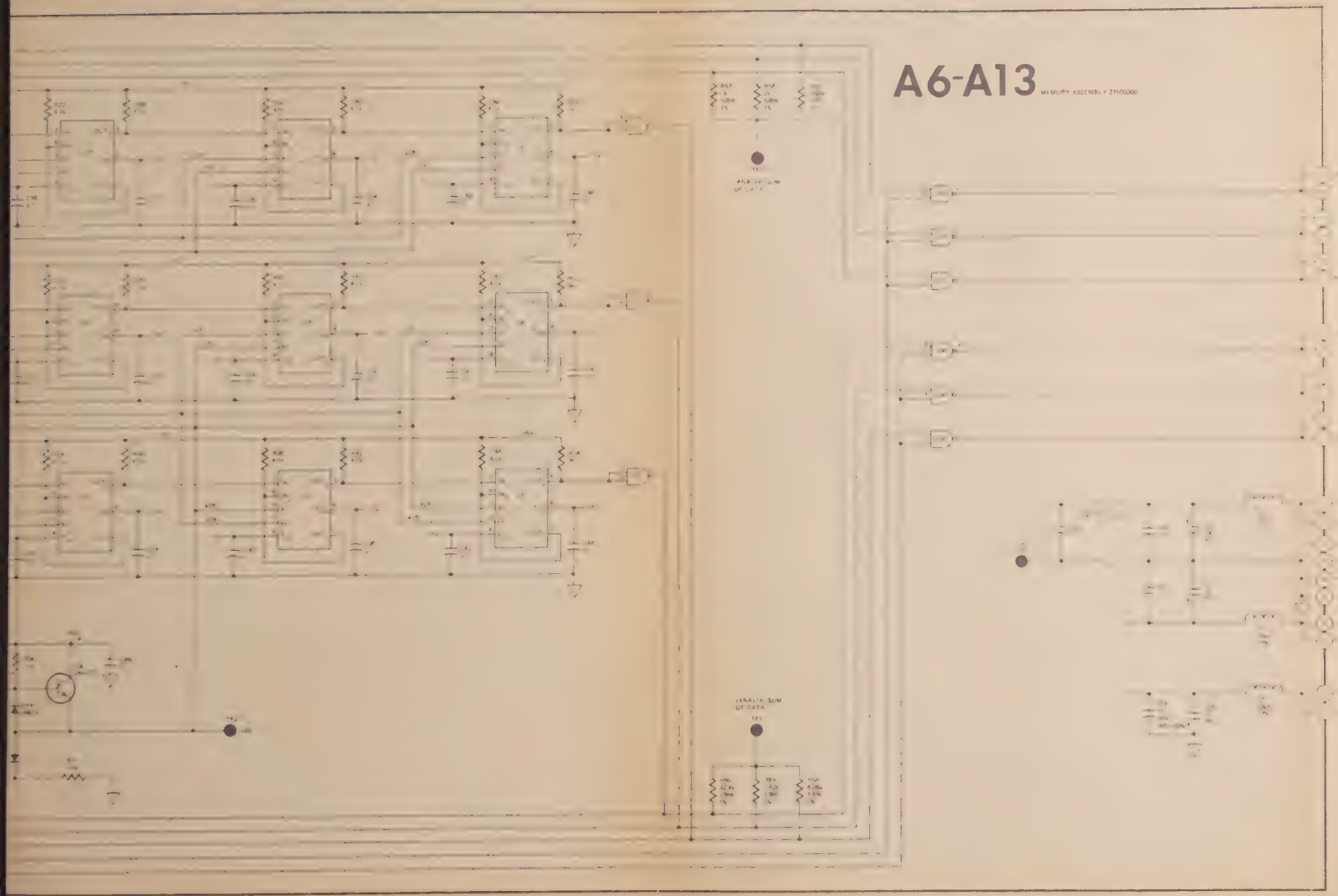
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO	TITLE: SCHEMATIC/COMPONENT LAYOUT MEMORY CONTROL ASSEMBLY 27527700 A5			
DRAWN: R.C. Mabry 4/73	MODEL: 13151	SIZE:	DRAWING NO: 27527800	REV: B
DESIGNED:	SCALE:		SHEET 1 OF 1	
CHECKED: D. Ober				
ENGINEER: J. J. Ferris				
APPROVED:				


A6-A13



A6-A13

MEMORY ASSEMBLY 27500300



REVISIONS

A			
B			
C	R48-54 WERE 4		

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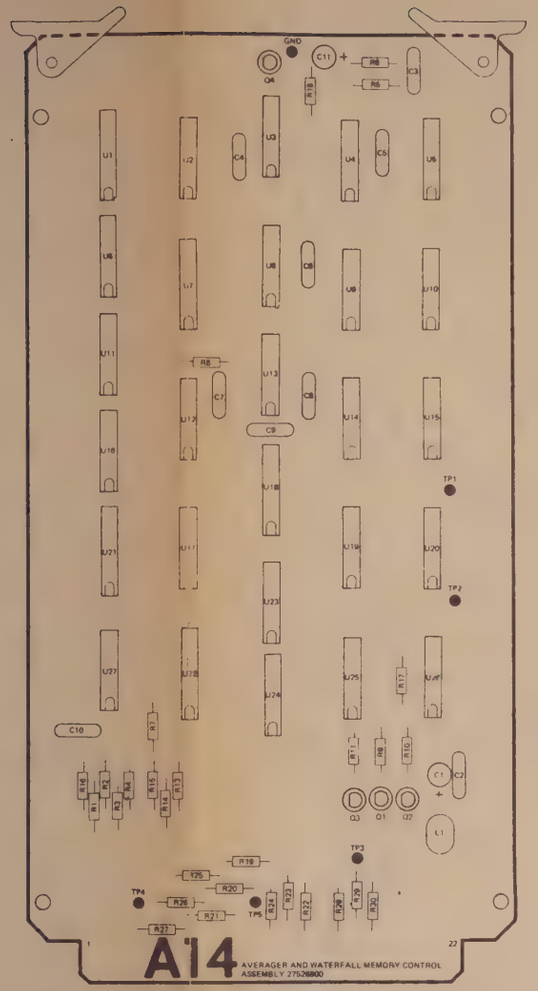
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

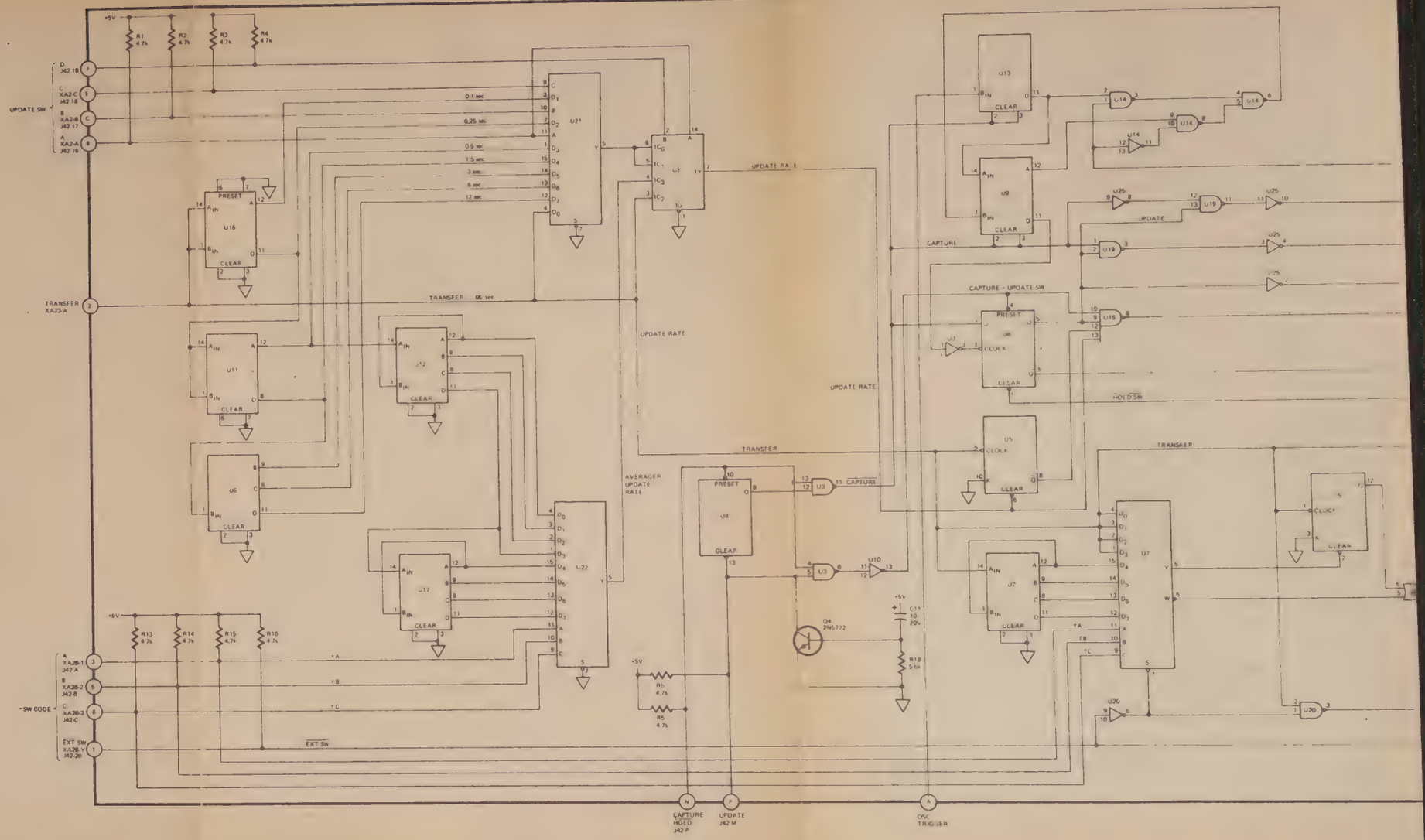
DRAWN		DATE	
ISSUED			
CHK'D			
ENGR'G			
APPROVED			

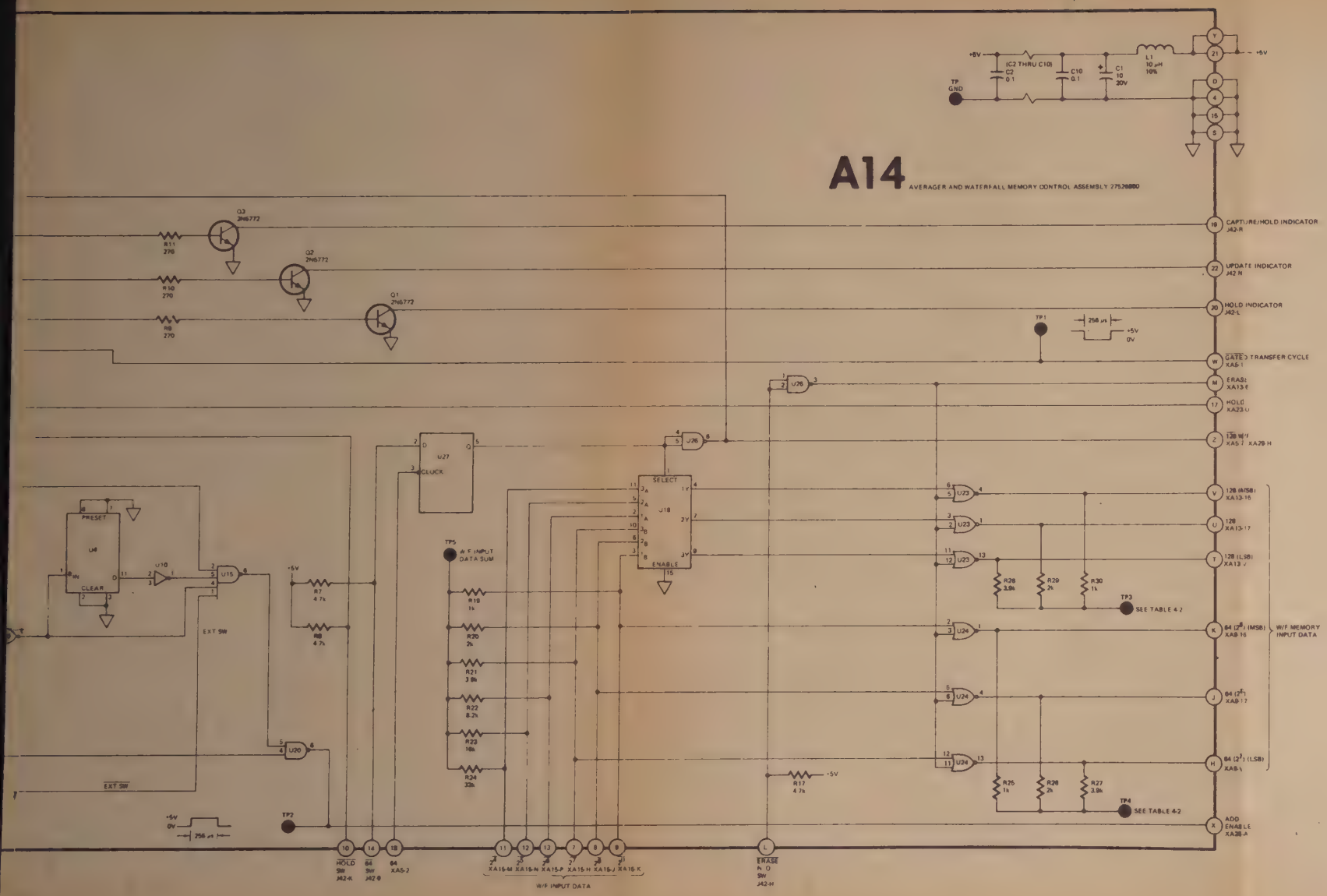
TITLE: SCHEMATIC/COMPONENT LAYOUT
MEMORY
ASSEMBLY 27500300

A6-A13

MODEL	SIZE	DRAWING NO.	REV
13151		27525A00	C
SCALE		SHEET	OF 1


A14
AVERAGER AND WATERFALL MEMORY CONTROL
ASSEMBLY 27526800


+5V
UPDATE SW
TRANSFER
XA23-A
+SW CODE
EXT SW
0.1 sec
0.25 sec
0.5 sec
1.5 sec
3 sec
6 sec
12 sec
TRANSFER .06 sec
UPDATE RATE
AVERAGER UPDATE RATE
CAPTURE
UPDATE
CAPTURE - UPDATE SW
HOLD SW
TRANSFER
CAPTURE HOLD J42-P
UPDATE J42-M
OSC TRIGGER



REVISIONS						
REV	ECO	S/W	DESCRIPTION	DRAFT	CHECK	APPR
B		011	REDRAWN	L S 3-73		11

NOTES UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/4W, ±5%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS @ 12V, ±20%

INTEGRATED CIRCUITS				
REF. DESIG.	PART NO.	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1	SN74153N	8	16	
U2,U6,U9 U12,U13 & U17	SN7403N	10	5	
U3,U14,U19 & U20	SN7400N	7	14	U3C,U19B,U19C & U20D
U4 & U16	SN74S80N	10	5	
U5	SN74173N	11	4	
U7,U21 & U22	SN74151N	8	16	
U8 & U27	SN7474N	7	14	U27B
U10,U23 & U24	SN7402N	7	14	U10C,U23C,U24C
U11	SN7402N	10	5	
U15	SN7420N	7	14	
U18	SN74157N	8	16	
U26	SN7404N	7	14	U25C & U25F
U28	SN7437N	7	14	U28C & U28D

HIGHEST REF DESIG USED
C11
L1
Q4
R30
TP5
U27

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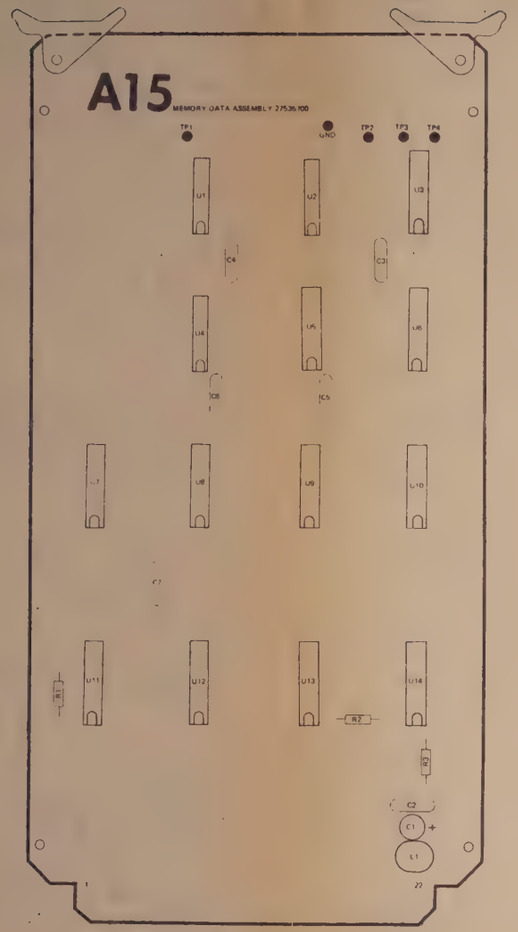
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

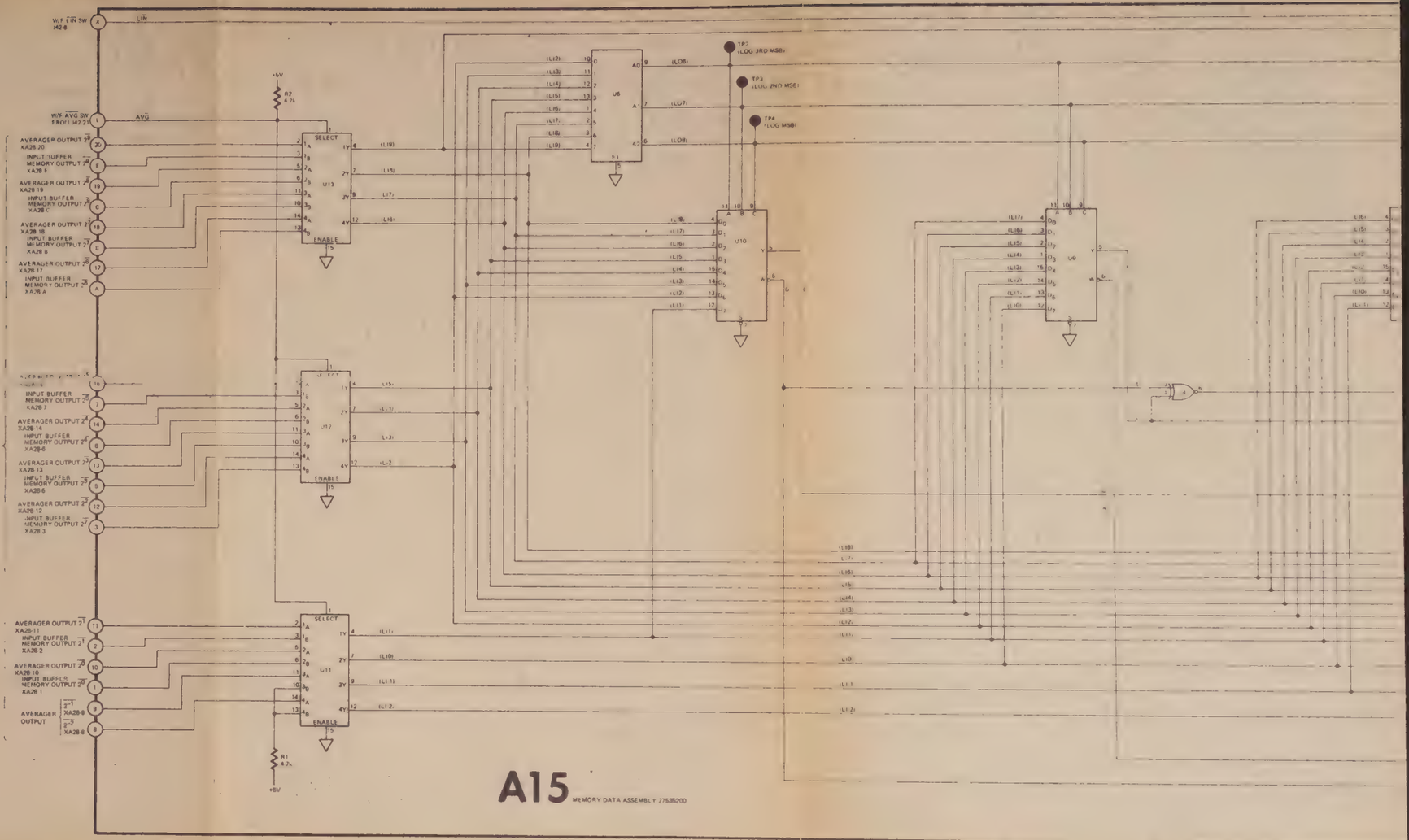
TITLE: SCHEMATIC/COMPONENT LAYOUT AVERAGER AND WATERFALL MEMORY CONTROL ASSEMBLY 27526800 — A14

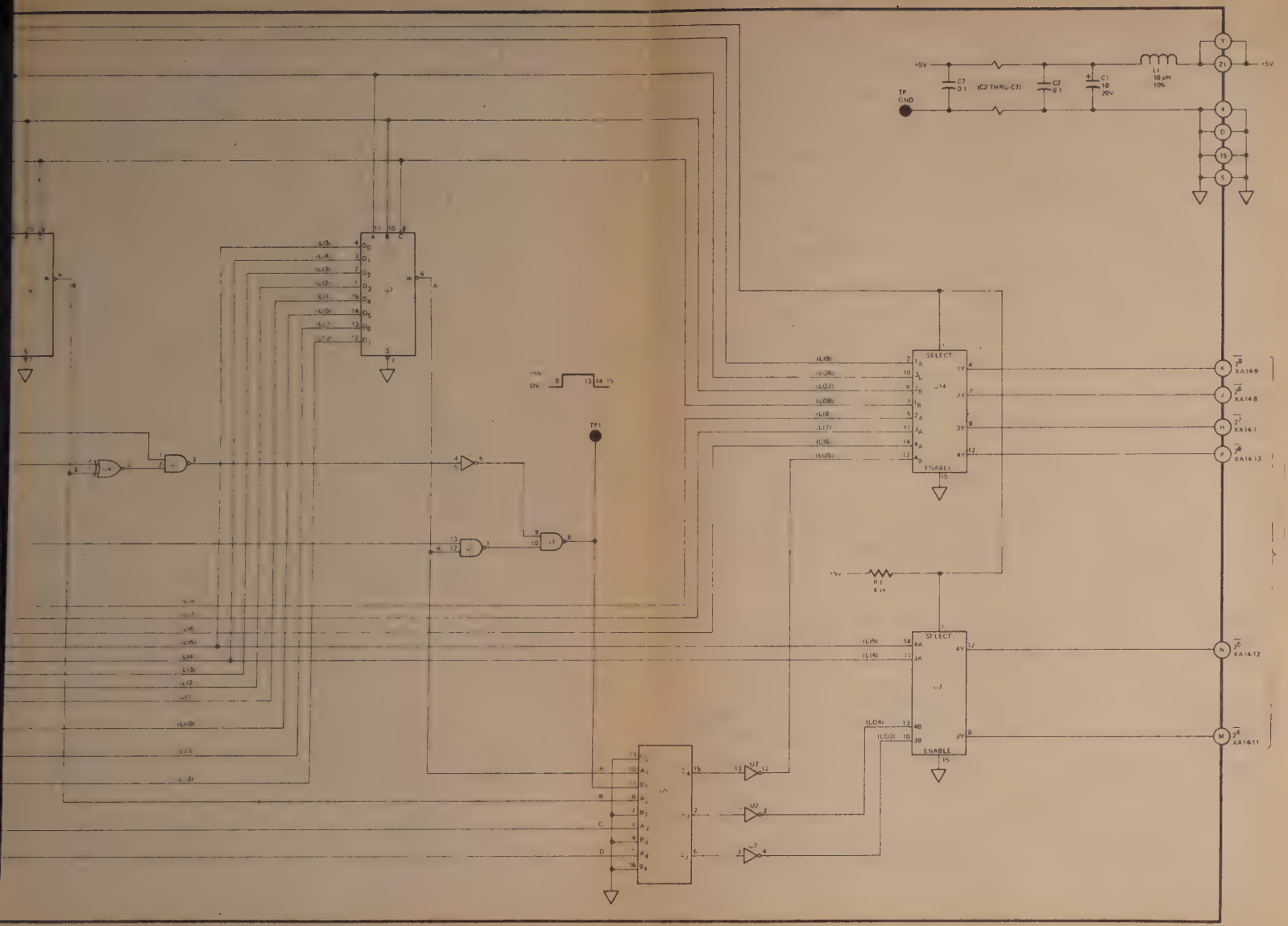
DRAWN	L SAUER	3-73
DESIGNED		
CHECKED		
ENGINEER		
APPROVED		

MODEL	SIZE	DRAWING NO	REV
13151		27526900	B

SCALE — SHEET 1 OF 1


A15
MEMORY DATA ASSEMBLY 27535100
TP1
GND
TP2
TP3
TP4
U1
U2
U3
C4
C3
U4
U5
U6
IC8
IC5
U7
U8
U9
U10
C7
U11
U12
U13
U14
R1
R2
R3
C2
C1
L1
J2


W/E LIN SW J42-6
LIN
W/E AVG SW FROM J42-21
AVG
+5V
R7 4.7k
AVERAGER OUTPUT 2^7 XA28-20
INPUT BUFFER MEMORY OUTPUT 2^6 XA28-F
AVERAGER OUTPUT 2^5 XA28-19
INPUT BUFFER MEMORY OUTPUT 2^4 XA28-C
AVERAGER OUTPUT 2^3 XA28-18
INPUT BUFFER MEMORY OUTPUT 2^2 XA28-9
AVERAGER OUTPUT 2^1 XA28-17
INPUT BUFFER MEMORY OUTPUT 2^0 XA28-A
SELECT
U13
ENABLE
FROM A2b
INPUT BUFFER MEMORY OUTPUT 2^7 XA28-7
AVERAGER OUTPUT 2^6 XA28-14
INPUT BUFFER MEMORY OUTPUT 2^5 XA28-6
AVERAGER OUTPUT 2^4 XA28-13
INPUT BUFFER MEMORY OUTPUT 2^3 XA28-5
AVERAGER OUTPUT 2^2 XA28-12
INPUT BUFFER MEMORY OUTPUT 2^1 XA28-3
U12
AVERAGER OUTPUT 2^7 XA28-11
INPUT BUFFER MEMORY OUTPUT 2^6 XA28-2
AVERAGER OUTPUT 2^5 XA28-10
INPUT BUFFER MEMORY OUTPUT 2^4 XA28-1
AVERAGER OUTPUT 2^3 XA28-9
AVERAGER OUTPUT 2^2 XA28-8
U11
R1 4.7k
+5V
U6
U10
U9
TP2 (LOG 3RD MSB)
TP3 (LOG 2ND MSB)
TP4 (LOG MSB)
A15
MEMORY DATA ASSEMBLY 27535200



REVISIONS					
REV	ECN	DESCRIPTION	DATE		
A	011	REDRAWN	P H 3 73		

NOTES UNLESS OTHERWISE INDICATED

1 (a) RESISTANCE SHOWN IN OHMS

(b) RESISTORS ARE 1/4W ±5%

(c) CAPACITANCE SHOWN IN MICROFARADS

(d) CAPACITORS @ 12V ± 20%

INTEGRATED CIRCUITS				
		PWR PINS		UNUSED CIRCUITS
REF DESIG	PART NO.	GND	VCC	
U1	SN7400N	7	14	
U2	SN7404N	7	14	U2C, D, E
U4	SN7486N	7	14	U4C, D
U5	SN7483N	12	5	
U6	SN74148N	8	16	
U7,U8,U9, U10	SN74151N	8	16	
U3,U11,U12, U13,U14	SN74157N	8	16	

HIGHEST REF DESIG USED
C7
L1
R3
TP4
U14

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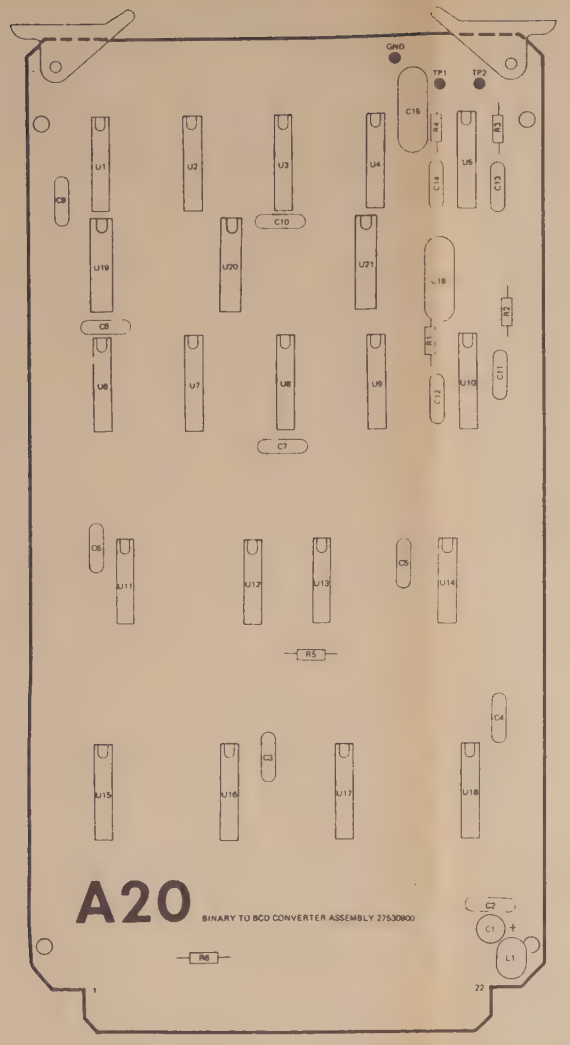
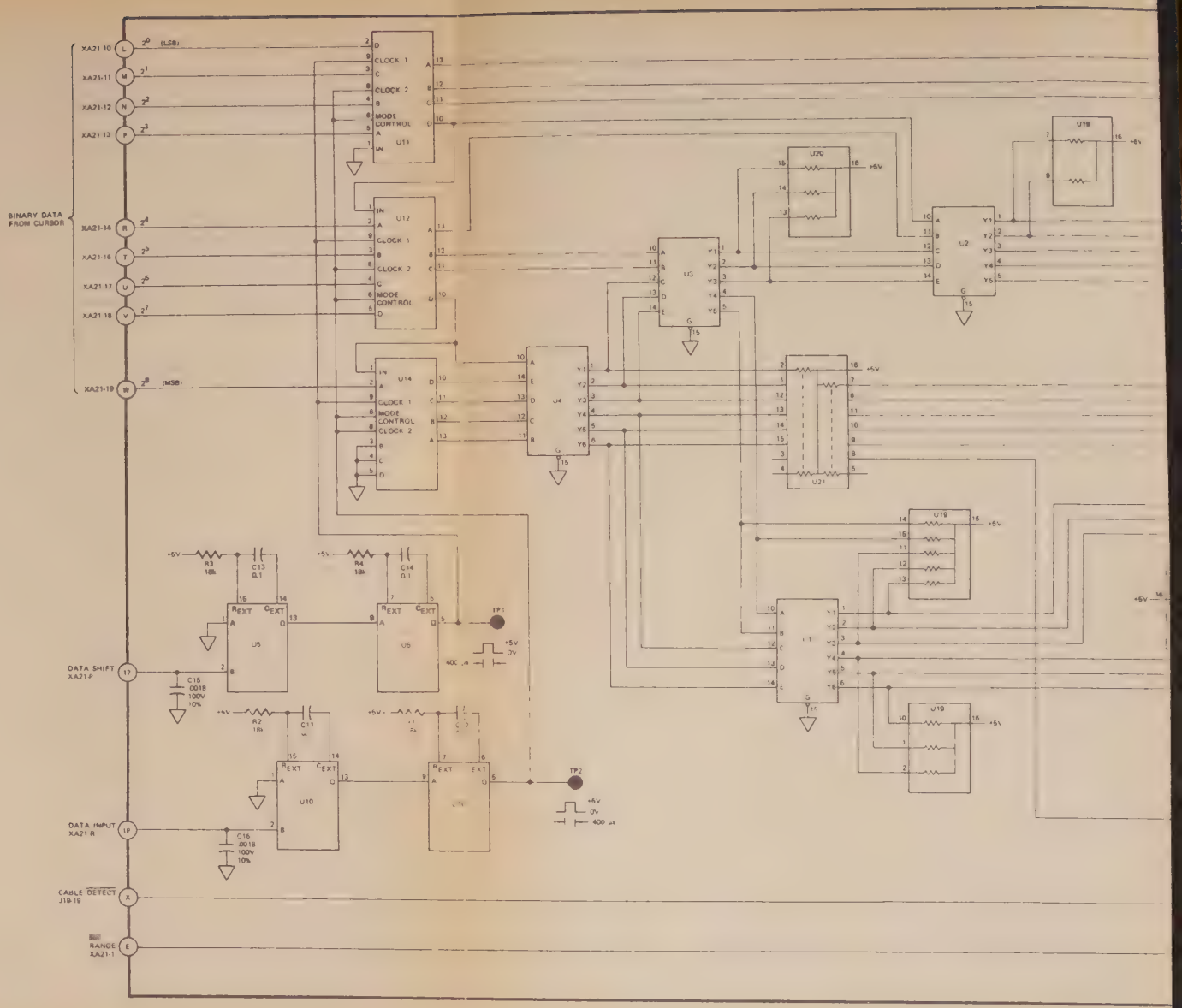
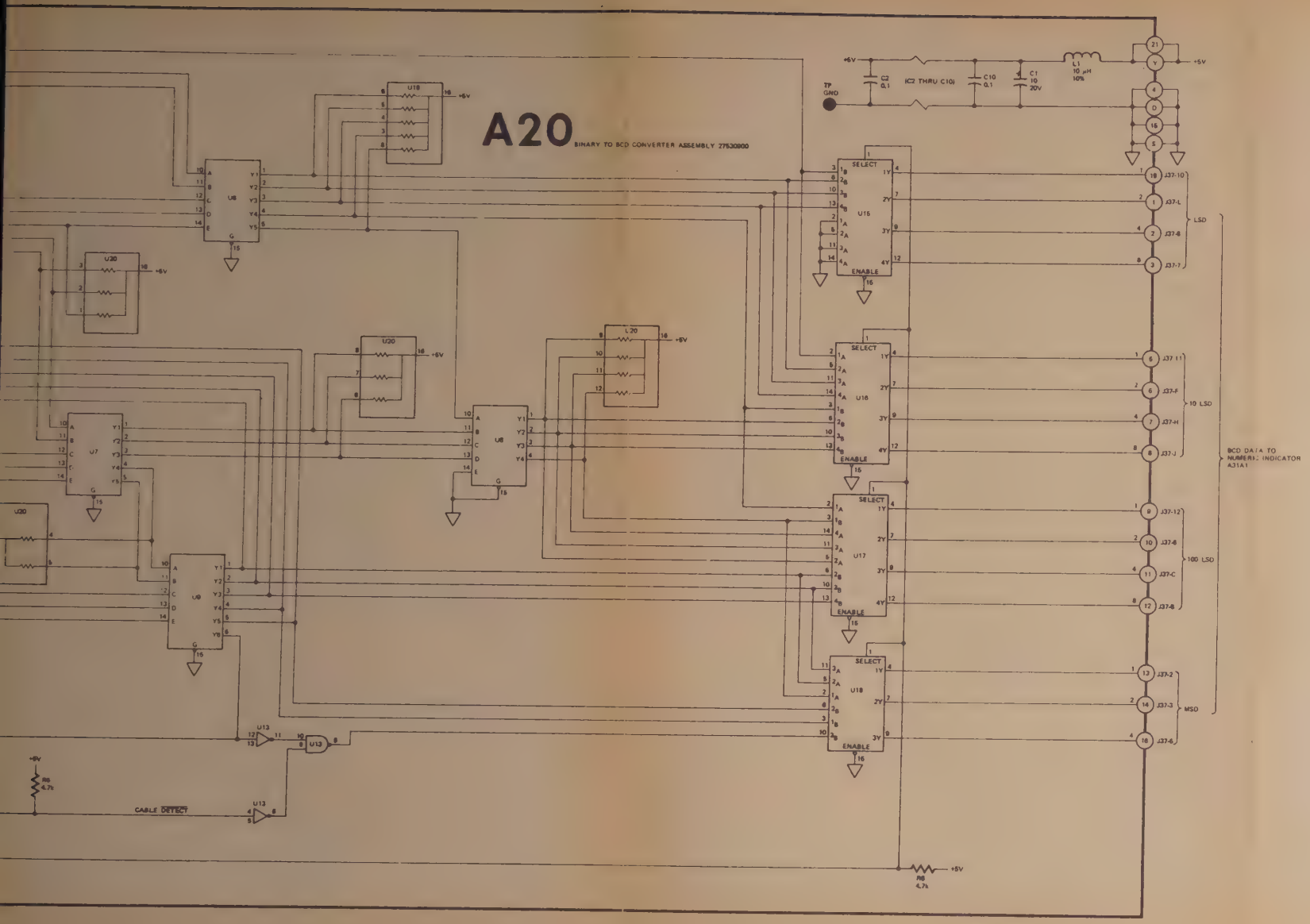
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: SCHEMATIC/COMPONENT LAYOUT MEMORY DATA ASSEMBLY 27535200 A15

DRAWN	P. HAASE	3 73	MODEL 13151	SIZE	DRAWING NO. 27535100 REV A
DESIGNER					
CHECKED					
ENGINEER			SCALE		SHEET 1 OF 1
APPROVED					


GND
TP1
TP2
A20
BINARY TO BCD CONVERTER ASSEMBLY 27530900


BINARY DATA FROM CURSOR
XA21-10
XA21-11
XA21-12
XA21-13
XA21-14
XA21-16
XA21-17
XA21-18
XA21-19
(LSB)
(MSB)
DATA SHIFT XA21-P
DATA INPUT XA21-R
CABLE DETECT J19-19
RANGE XA21-1
+5V
0V
400 µs
TP1
TP2



REVISIONS						
REV	ECO	L/N	DESCRIPTION	DRAFT	CHECK	APP'D
A		011	REDRAWN	RVM 4-73		
B	DDC	081	ADDED U18, U20 AND U21	LS 10-74		

NOTES UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS.
   (b) RESISTORS ARE 1/4W, 5%.
   (c) CAPACITANCE SHOWN IN MICROFARADS.
   (d) CAPACITORS ARE 12V, 20%.

INTEGRATED CIRCUITS				
REF DESIG	PART NO	PWR PINS GND	PWR PINS +5V	UNUSED CIRCUITS
U1,U2,U3,U4, U6,U7,U9 & U9	SN74185AN	8	16	NONE
U5 & U10	SN74123N	8	16	NONE
U11 U12 & U14	SN7405AN	7	14	NONE
U13	SN7400N	7	14	U13A
U15,U16,U17 & U18	SN74157N	8	16	NONE
U18, U20, U21	886-1-R4.7K	–	–	NONE

HIGHEST REF DESIG. USED
C10
L1
R8
TP2
U21

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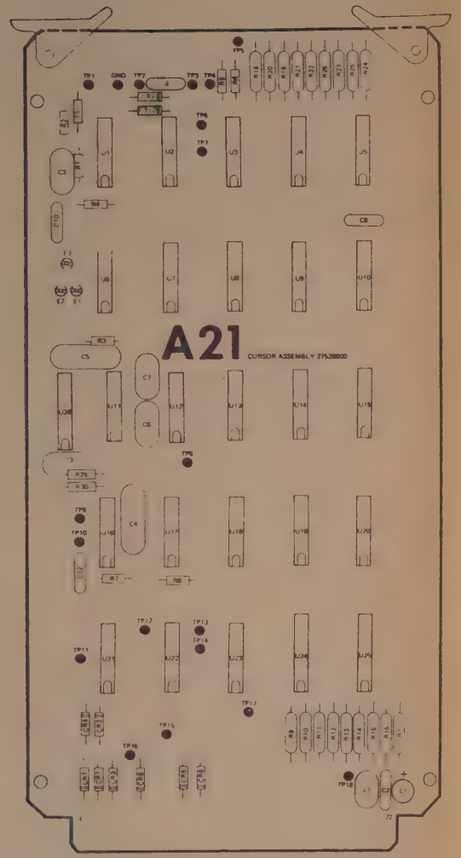
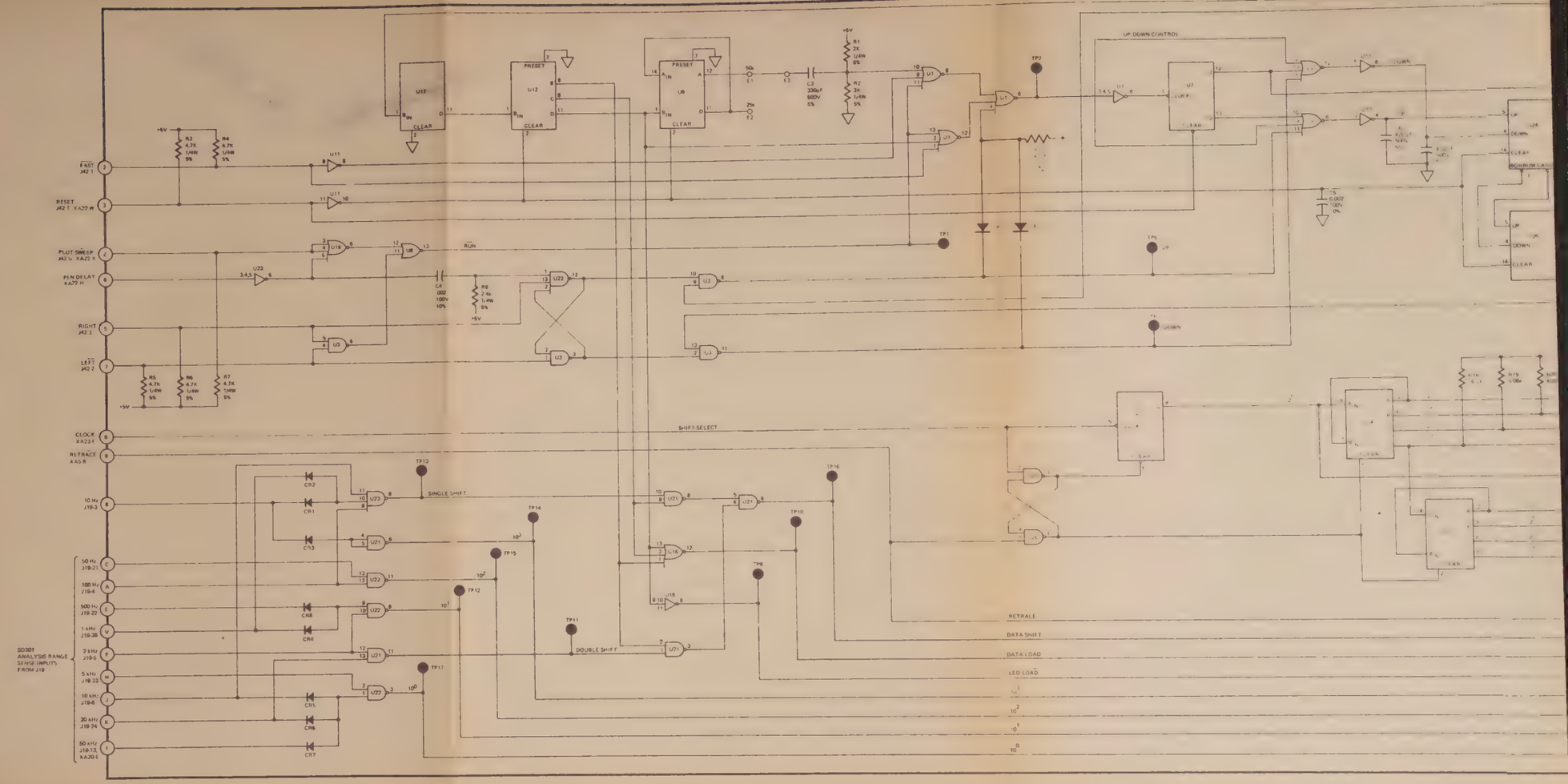
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

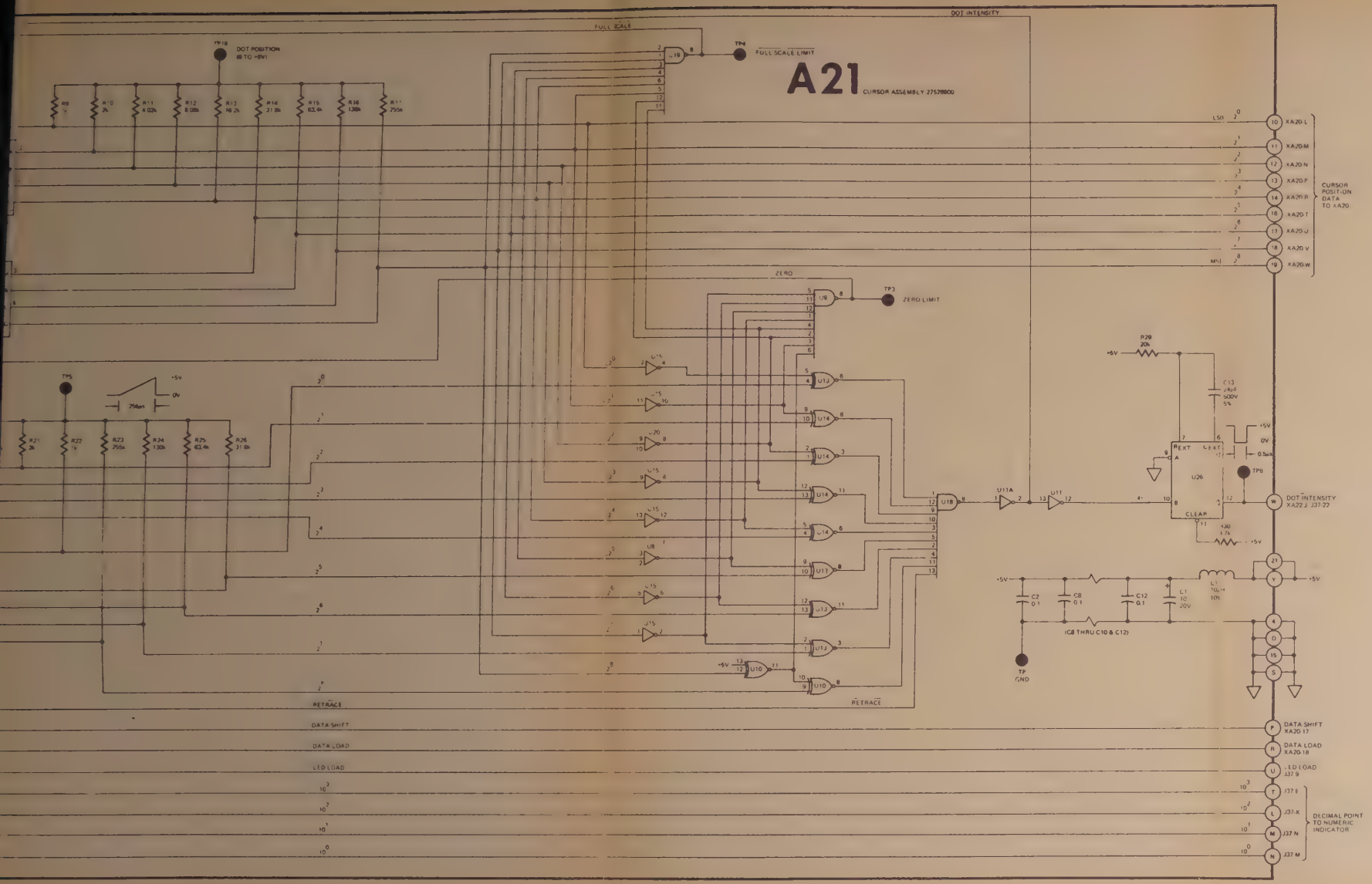
TITLE: SCHEMATIC/COMPONENT LAYOUT BINARY TO BCD CONVERTER ASSEMBLY 27530900 A20

DRAWN	R. V. McCOY	6-73
DESIGNER		
CHECKED		6-73
ENGINEER		6-73
APPROVED		6-13-73

MODEL	SIZE	DRAWING NO.	REV
13151		27531000	B
SCALE		SHEET 1 OF 1	


A21
CURSOR ASSEMBLY 7752800


UP DOWN CONTROL
FAST J42 1
RESET J42 T XA22 W
PLOT SWEEP J42 U XA22 X
PEN DELAY XA27 H
RIGHT J42 3
LEFT J42 2
CLOCK XA23 F
RETRACE XA5 B
10 Hz J19-3
50 Hz J19-21
100 Hz J19-4
500 Hz J19-22
1 kHz J19-38
2 kHz J19-5
5 kHz J19-23
10 kHz J19-6
20 kHz J19-24
50 kHz J19-13, XA20-E
SD301 ANALYSIS RANGE SENSE INPUTS FROM J19
RUN
SINGLE SHIFT
DOUBLE SHIFT
SHIFT SELECT
RETRACE
DATA SHIFT
DATA LOAD
LED LOAD



REVISIONS						
REV	P.C.	S/N	DESCRIPTION	DATE	CHECK	APPD
B		011	REDRAWN	L.S. 3-73		
C	1816	011	ADDED U38, R27, R28, C11 AND C12.	L.S. 10-74		
D	1947	081	ADDED U26B, R29, R30 & C13. NOTE 8. C11 WAS 47pF.	GBC 3-75		
E	2424		DELETED C11, U26A, R27, R28.			
F	2424	84	ADDED U26A, R27, R28.			

NOTES UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/8W, ±1%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS @ 12V, ±20%
2. DIODES ARE TYPE IN695
3. SYMBOL [ ] INDICATES FRONT PANEL LOCATION
4. SYMBOL [ ] INDICATES CHASSIS LOCATION

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1,U2 & U18	SN7427N	7	14	NONE
U3,U20 & U21	SN7400N	7	14	U20D
U4,U5 & U17	SN7403AN	10	5	NONE
U6 & U12	SN7490AN	10	5	NONE
U7	SN7473N	11	4	NONE
U8	SN7402N	7	14	U8C
U9 & U19	SN7430N	7	14	NONE
U10,U13 & U14	SN7486N	7	14	U10A & U10B
U11 & U15	SN7404N	7	14	NONE
U16	MC1808P	7	14	NONE
U22	SN7408N	7	14	NONE
U23	SN7410N	7	14	NONE
U24 & U25	SN74193N	8	16	NONE
U26	SN74123N	8	16	26A

HIGHEST REF DESIG USED
C13
CR1
E3
L1
R3
TP18
U26

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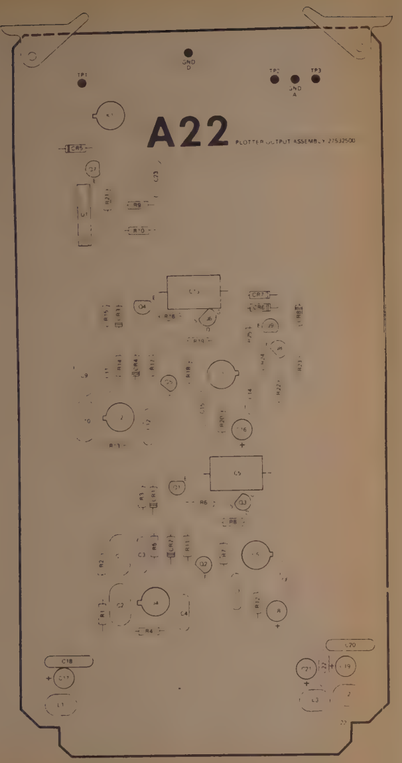
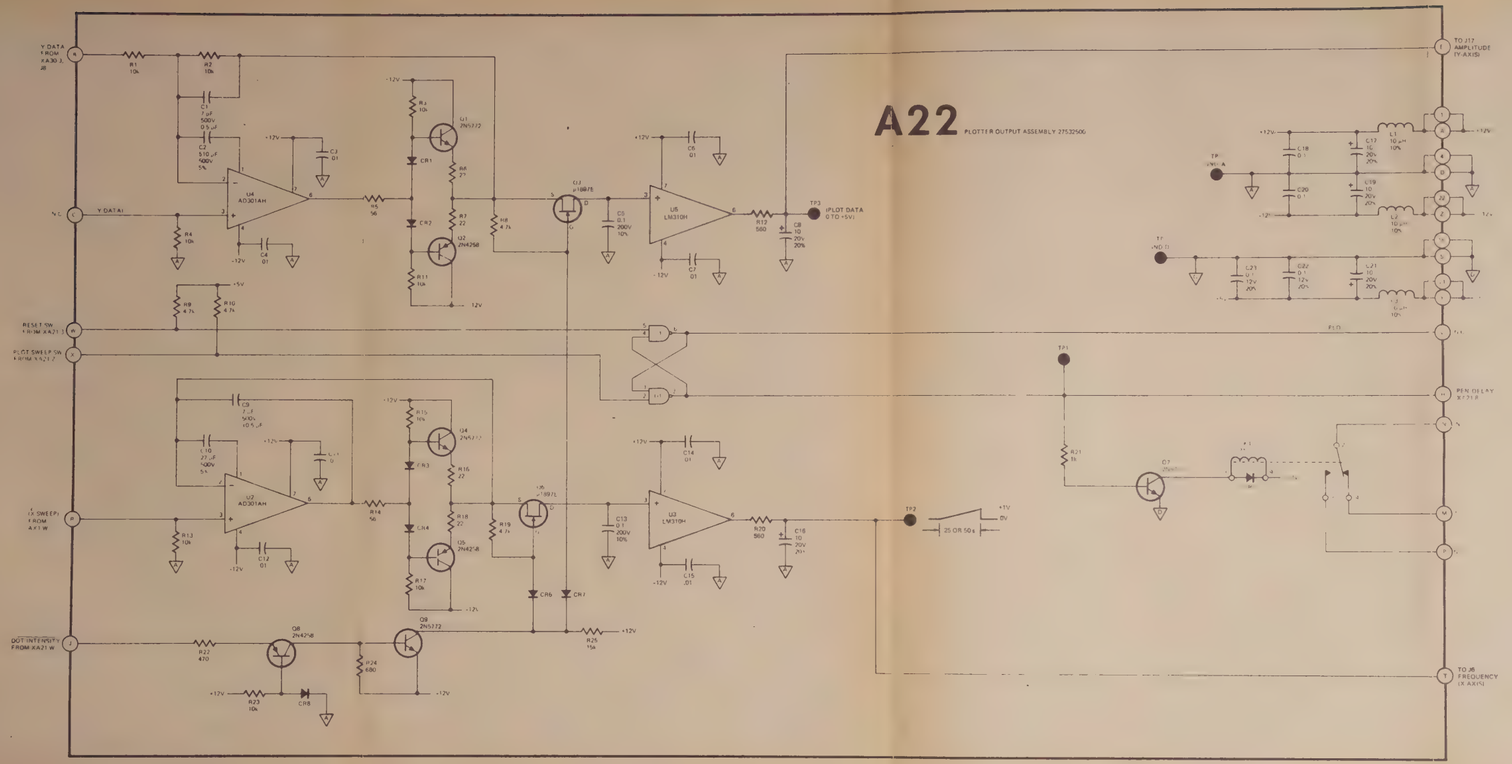
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: SCHEMATIC/COMPONENT LAYOUT CURSOR ASSEMBLY 27528900 A21

DRAWN	L SAUER	3-73
DESIGNER		
CHECKED	[illegible]	5-73
ENGINEER	[illegible]	[illegible]
APPROVED	[illegible]	[illegible]

MODEL	SIZE	DRAWING NO	REV
13151		27529000	F
SCALE		SHEET 1 OF 1	





REVISIONS						
LTR	ECO	S/N	DESCRIPTION	DRAFT	CHK'D	APP'D
A		001	REDRAWN	RVM 4/73		

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/4W 5%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS ARE 25V ±80% -20%
2. DIODES ARE TYPE 1N914

INTEGRATED CIRCUITS				
REF DES:	PART NO.	PIN NO.		UNUSED CIRCUITS
		NO		
U5	LM340K	-	14	UNUSED

HIGHEST REF DESIG. USED
C23
R9
K1
Q2
TP9
R25
TP3
U7

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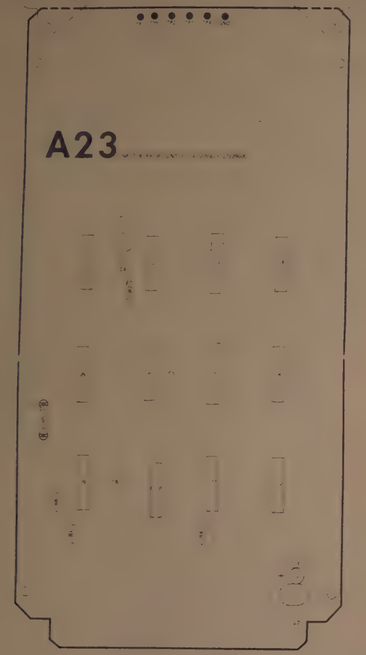
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

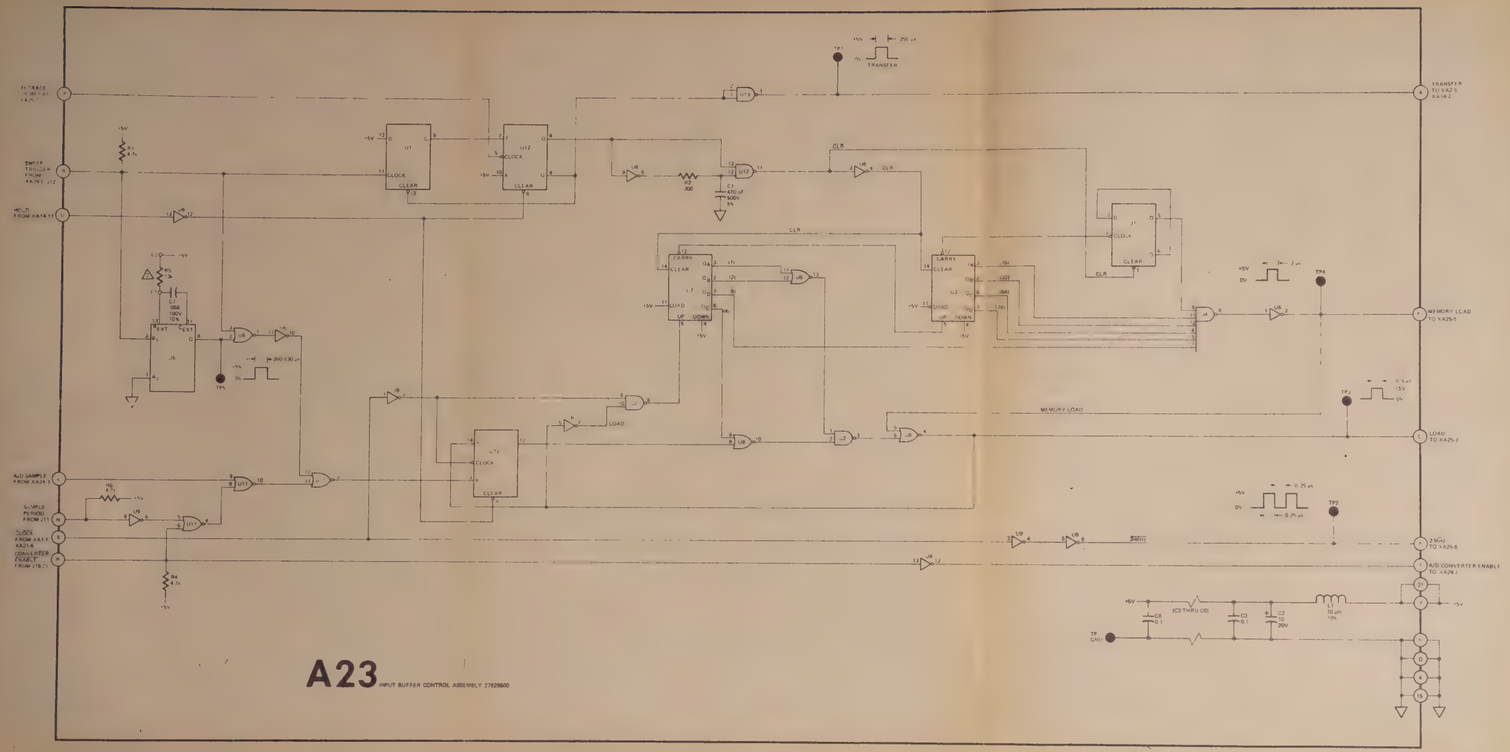
TITLE: SCHEMATIC/COMPONENT LAYOUT PLOTTER OUTPUT ASSEMBLY 27532500

A22

DRAWN	R. McCOY	4/73
DESIGNER		
CHECKED	L. GRAY	5-73
ENGINEER	R. WAY	6-73
APPROVED		

MODEL	SIZE	DRAWING NO.	REV
13151		27525700	A
SCALE		SHEET 1 OF 1	





REVISIONS					
REV	ECN	DESCRIPTION	DRAWN	CHK'D	APP'D
C		U11			
D	0648				
E	0651				

NOTES: UNLESS OTHERWISE INDICATED

1. RESISTANCE SHOWN IN OHMS
   (M) RESISTORS ARE 1 MW 20%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS = 12V ±20%

⚠ ADJUST VALUE OF R5 AT FACTORY CHECKOUT TO OBTAIN A PULSE WIDTH OF 260±30 µs AT U5 - PIN 6

INTEGRATED CIRCUITS				
REF. DESIG.	PART NO.	PIN NO. GND	PIN NO. VCC	PAIRED CIRCUITS
U1	SN7474N	7	14	
U2	SN74109N	7	14	U2B
U3 thru U7	SN74193N	8	16	
U4	SN74109N	7	14	
U5	uA9322	7	14	NONE
U6 & U8	SN74040N	7	14	U8C & U8F
U8 & U11	SN74025N	7	14	U5A, U11A & U11B
U12	SN74139N	8	16	
U13	SN74221N	8	16	

HIGHEST REF DESIG. USED
U13

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SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

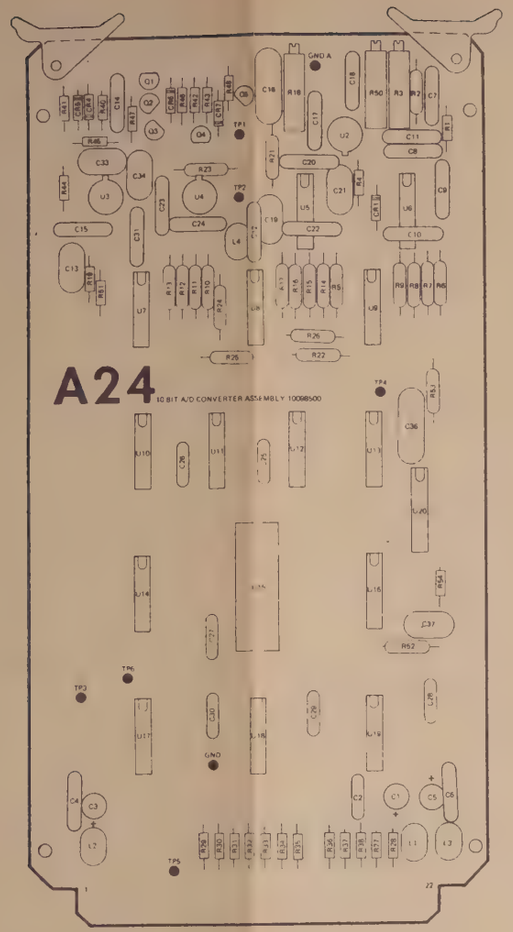
	NAME	DATE
DRAWN		
DESIGNED		
CHECKED		
ENGINEER		
APPROVED		

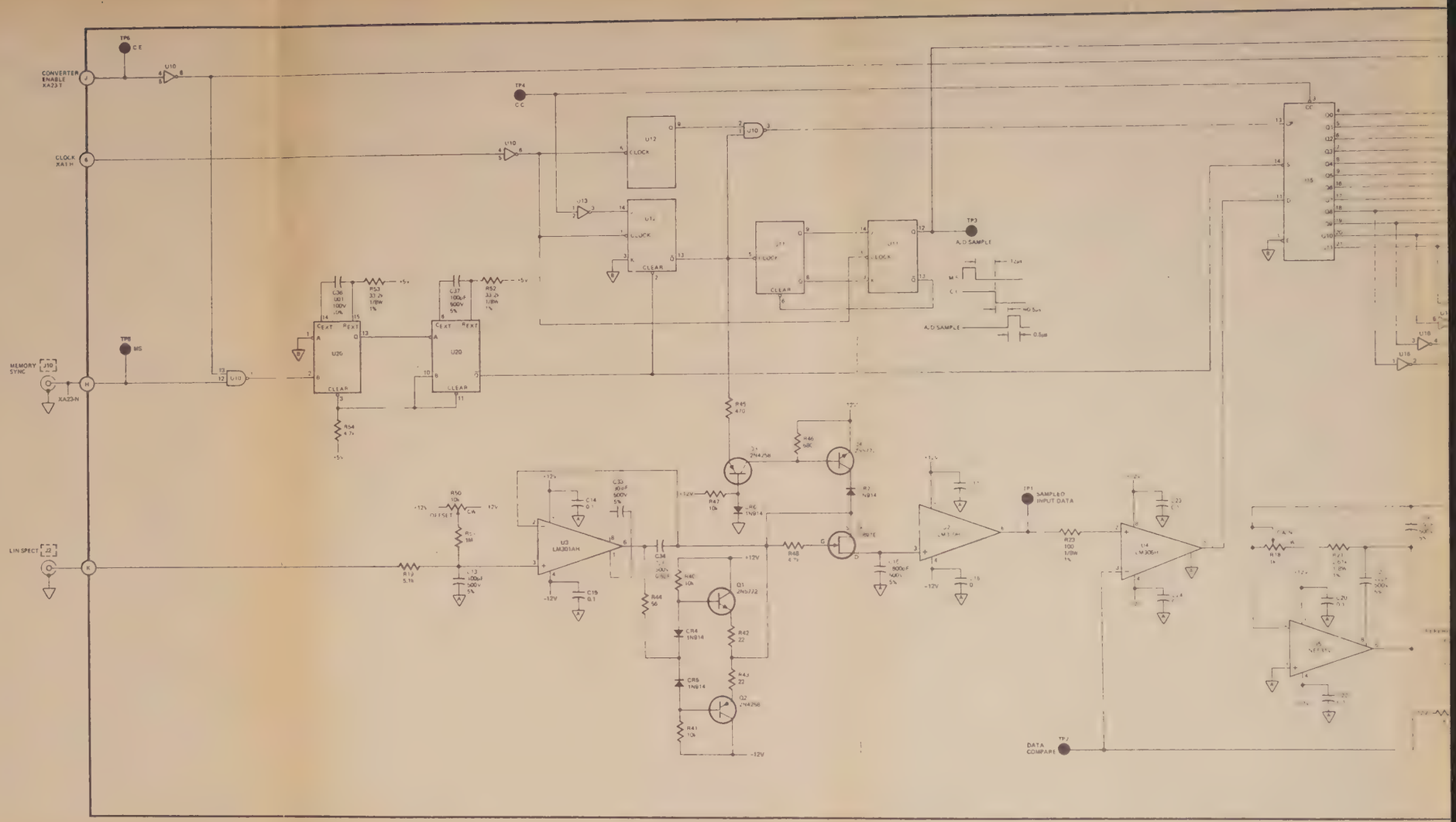
TITLE: SCHEMATIC/COMPONENT LAYOUT
INPUT BUFFER CONTROL
ASSEMBLY 27529500

A23

MODEL	SIZE	DRAWING NO.	REV
13151		27529600	E

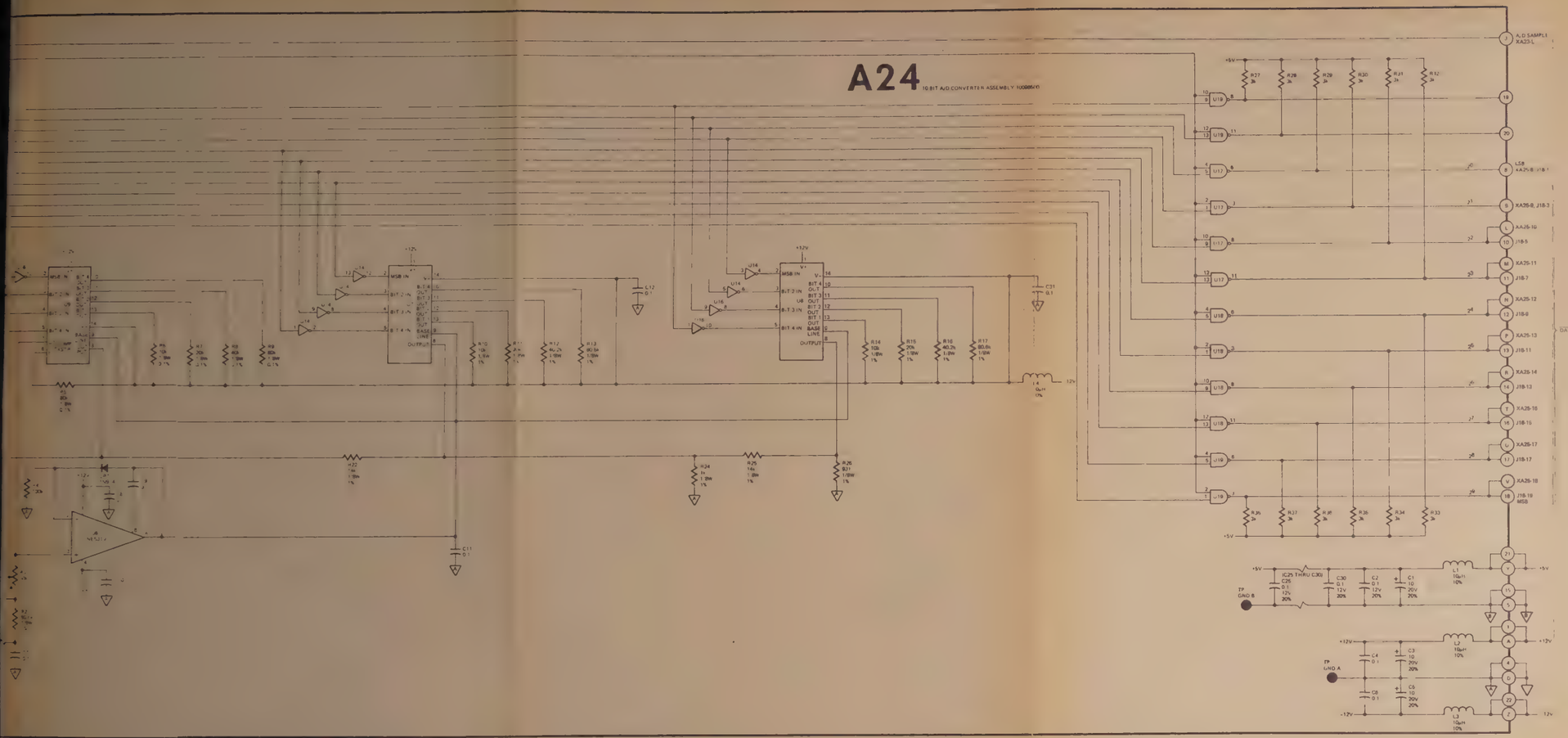
SCALE: | SHEET:


A24
10 BIT A/D CONVERTER ASSEMBLY 10098500


CONVERTER ENABLE XA23-T
CLOCK XA1-H
MEMORY SYNC J10
XA23-N
LIN SPECT J2
TP6 CE
TP4 CC
TP5 MS
A/D SAMPLE
SAMPLED INPUT DATA
DATA COMPARE
U3 LM301AH
U4 LM305H
2N4258
2N5772
2N5772
CLEAR
CLOCK

A24

10 BIT A/D CONVERTER ASSEMBLY 10098500



REVISIONS						
REV	ECO	S/N	DESCRIPTION	DRAFT	MFG	APPD
A		026	REDRAWN	JS 9-74		
B	1877	061	C33 WAS 100 pF, 500V, 5% & CONN TO U3-1 &2 C36 WAS .002 µF 100V 10% C37 WAS 500 pF, 500V 5%	GBC 10-74		
C	1938	074	C19 WAS .12 pF, 500V 5%	GBL 7-75		

NOTES: (UNLESS OTHERWISE INDICATED)

1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/4 W, ±5%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS @ 25V -+80, -20%
2. SYMBOL [ ] INDICATES CHASSIS LOCATION.

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U7 & U8	ICL8018ACPD			NONE
U9	ICL8018ACPD			NONE
U10	SN7437N	7	14	NONE
U11 & U12	SN7473N	11	4	NONE
U13	SN7400N	7	14	U13B-U&D
U14 & U16	SN7404N	7	14	NONE
U15	AM2504DC	12	4	NONE
U17, U18 & U19	SN7403N	7	14	NONE
U20	SN74123N	8	16	NONE

HIGHEST REF DESIG USED

C37
R7
L4
Z5
K54
TP6
U20

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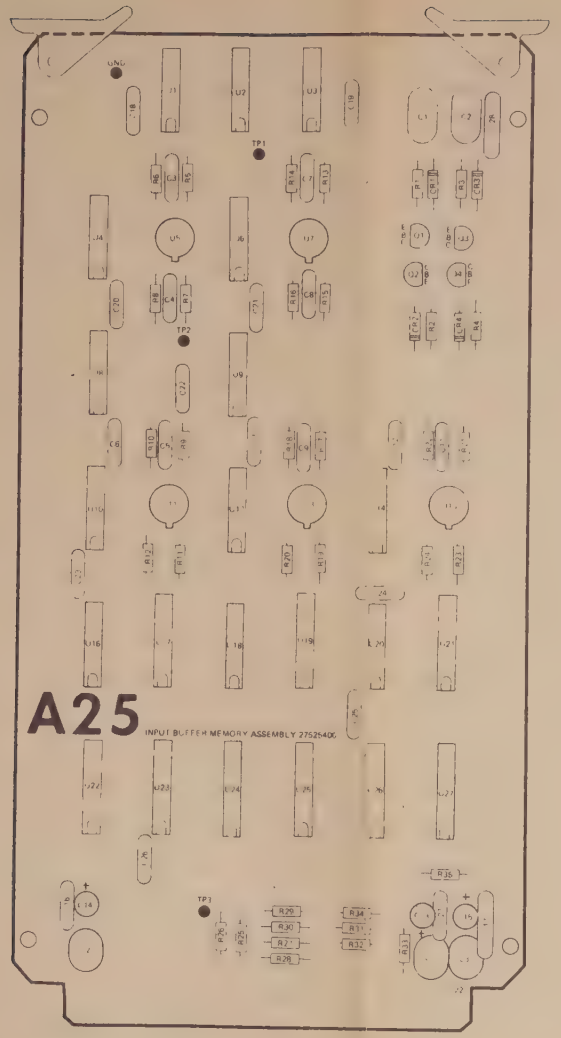
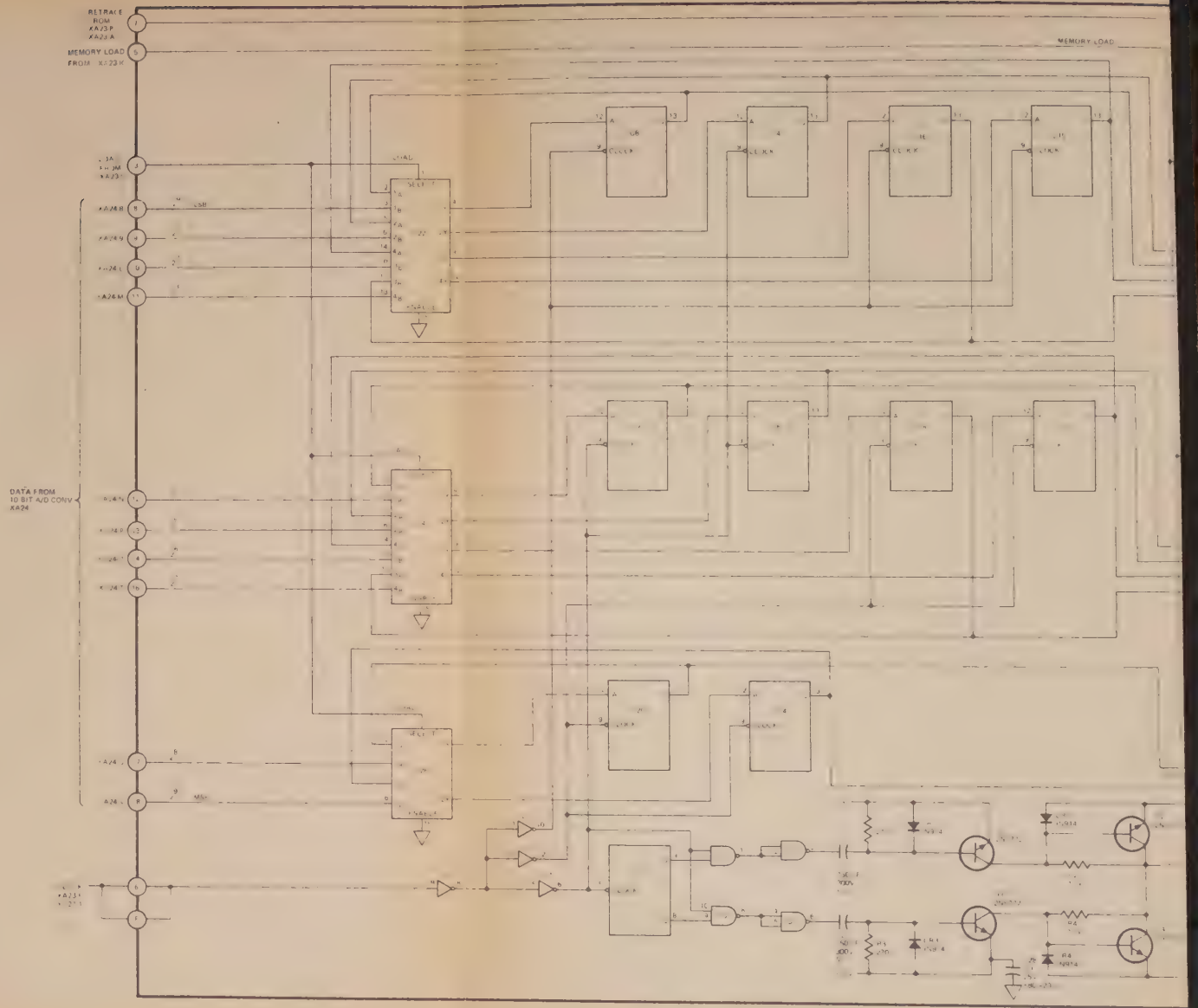
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

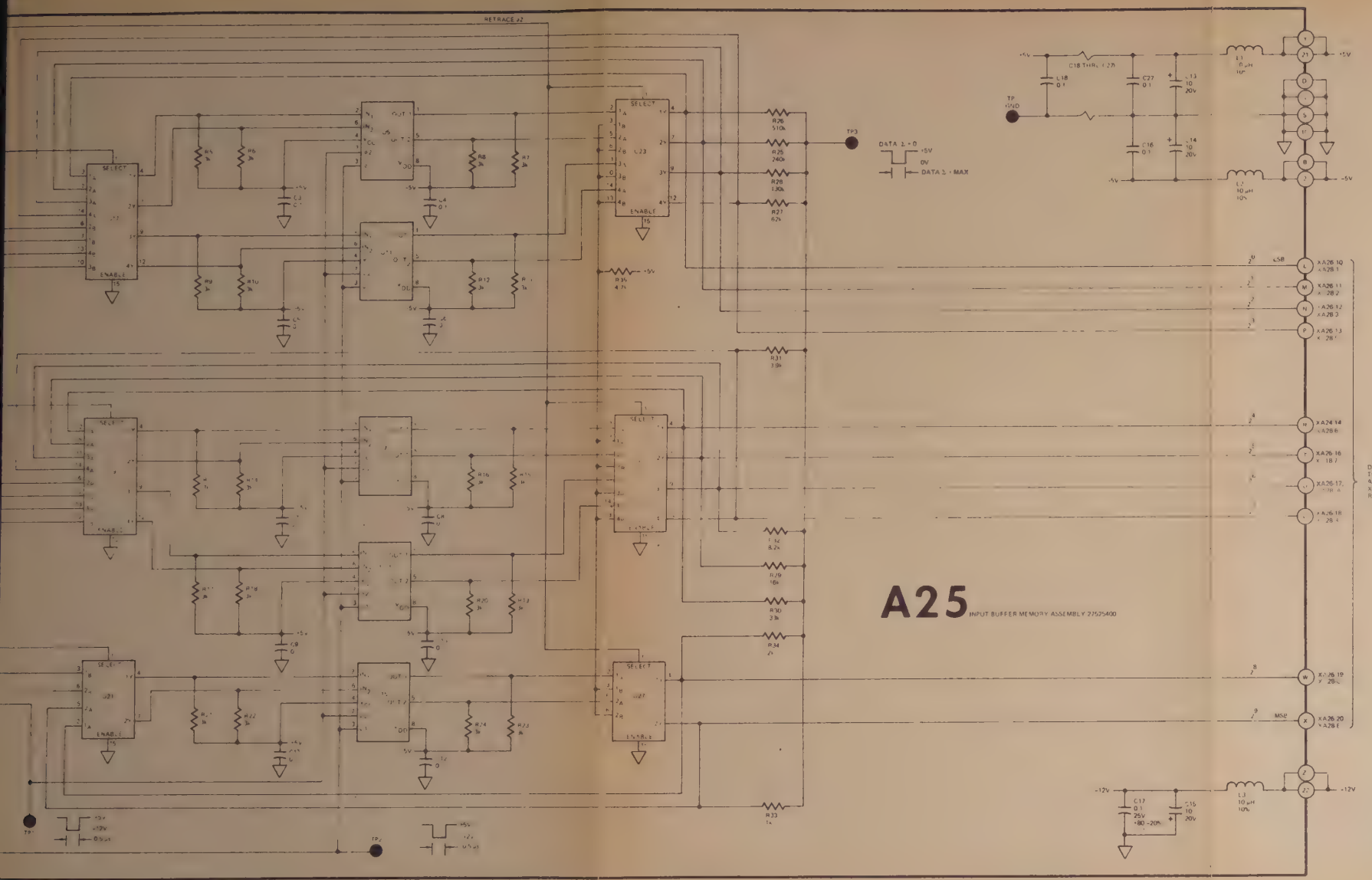
TITLE: SCHEMATIC/COMPONENT LAYOUT
10 BIT A/D CONVERTER
ASSEMBLY 10098500

A24

DRAWN	L. SAUER	8-74	MODEL 13151	SIZE	DRAWING NO. 10098700	REV C
DESIGNER						
CHECKED						
ENGINEER						
APPROVED			SCALE		SHEET 1 OF 1	


A25
INPUT BUFFER MEMORY ASSEMBLY 2752540C


RETRACE
ROM
XA23P
XA23A
MEMORY LOAD
FROM XA23K
MEMORY LOAD
DATA FROM
10 BIT A/D CONV
XA24



REVISIONS						
REV		S/N	DESCRIPTION	DRAFT		APP
A		011	REDRAWN	L S 3/73		

NOTES UNLESS OTHERWISE INDICATED

1 (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1.4W ±5%
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS @ 17V ±20%

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1	SN7404N	7	14	U1B,U1E
U2	SN7473N	11	4	U2A
U3	SN7437N	7	14	NONE
U4,U6,U8,U9, U10,U12,U14, U16,U18 & U20	SN7491A	10	5	NONE
U5,U7,U11,U13 U15	1403A	8	4	NONE
U17,U19,U21 U22,U23,U24, U25,U26 & U27	SN74157N	8	16	NONE

HIGHEST REF DESIG USED

U28
CR4
L3
J4
RJ5
TP3
U27

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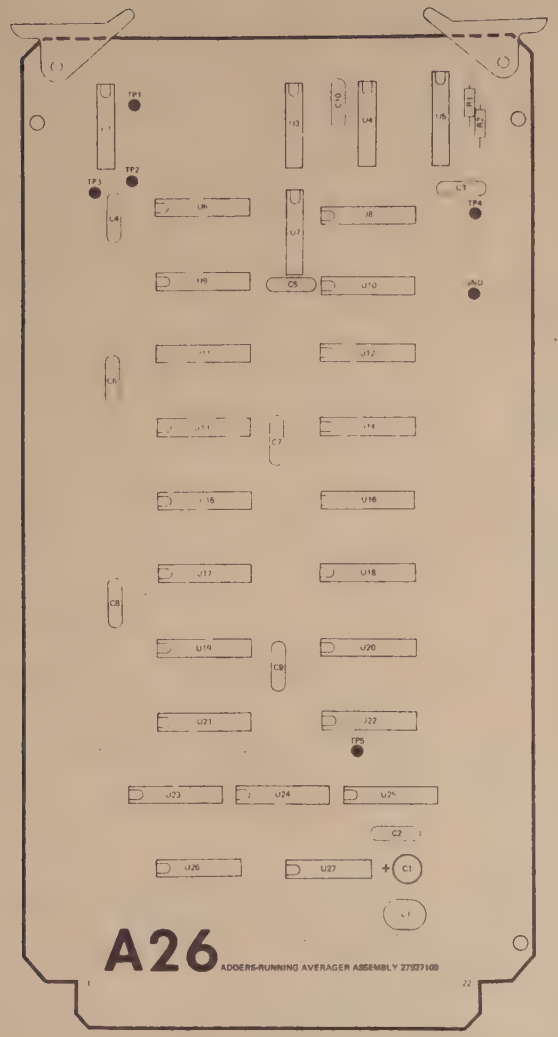
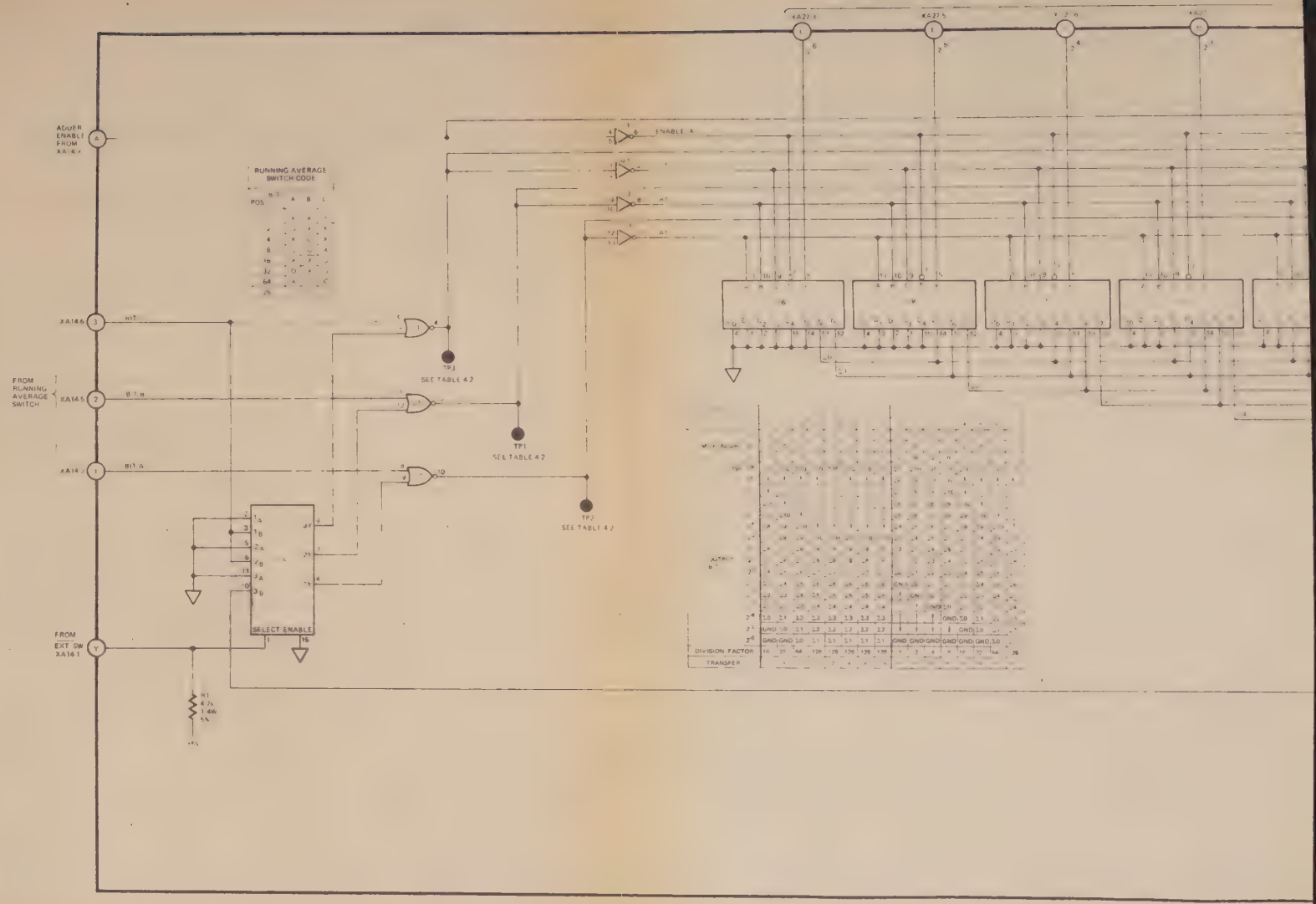
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

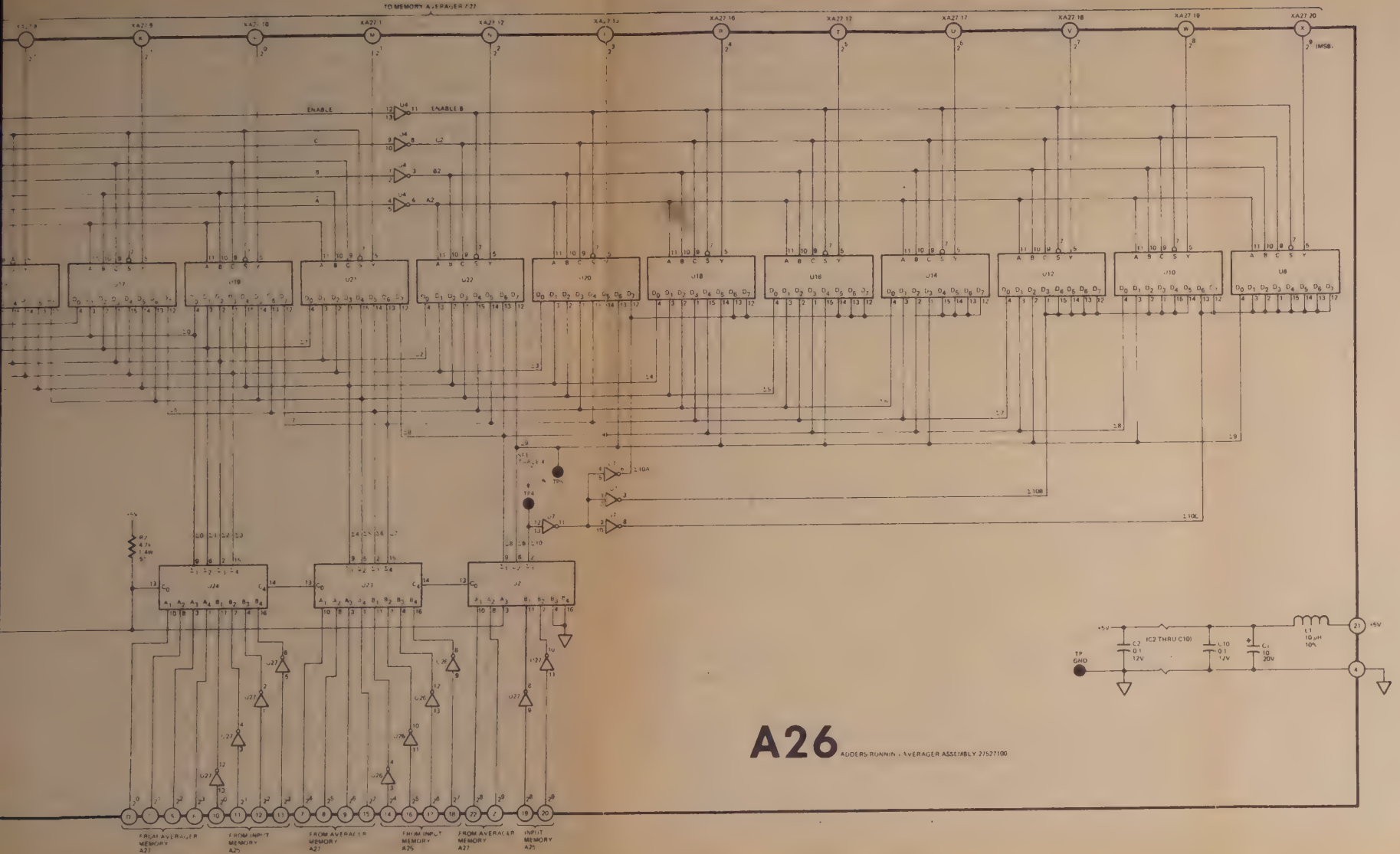
TITLE: SCHEMATIC/COMPONENT LAYOUT INPUT BUFFER MEMORY ASSEMBLY 27525400 A25

DRAWN	L SAUER	3/73
DESIGNER		
CHECKED		
ENGINEER		
APPROVED		

MODEL	SIZE	DRAWING NO	REV
13151		27525500	A
SCALE		SHEET 1 OF 1	


A26
ADDERS-RUNNING AVERAGER ASSEMBLY 27127108


ADDER ENABLE FROM XA 6A
RUNNING AVERAGE SWITCH CODE
POS
A
B
FROM RUNNING AVERAGE SWITCH
XA14-6
XA14-5
XA14-4
BIT C
BIT B
BIT A
FROM EXT SW XA16-1
SELECT ENABLE
ENABLE A
TP1
SEE TABLE 4.2
TP2
SEE TABLE 4.2
TP3
SEE TABLE 4.2
DIVISION FACTOR
TRANSFER



A26

ADDERS-RUNNING AVERAGER ASSEMBLY 27527100

REVISIONS						
REV	ECO	S/N	DESCRIPTION	DRAFT	CHK	APPD
A		011	REDRAWN	RVM 4-73		

NOTES UNLESS OTHERWISE INDICATED

1 (a) RESISTANCE SHOWN IN OHMS

(b) CAPACITANCE SHOWN IN MICROFARADS

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS +5V	UNUSED CIRCUITS
U1	SN7402N	7	14	U1A
U3,U4 & U7	SN7486N	7	14	NONE
U6	SN74167N	8	16	NONE
U8,U9- U22	SN74151N	8	16	NONE
U23,U24 & U25	SN7483N	12	5	NONE
U26 & U27	SN7404N	7	14	U26A & U26C

HIGHEST REF DESIG USED
C10
L1
H2
TP5
U27

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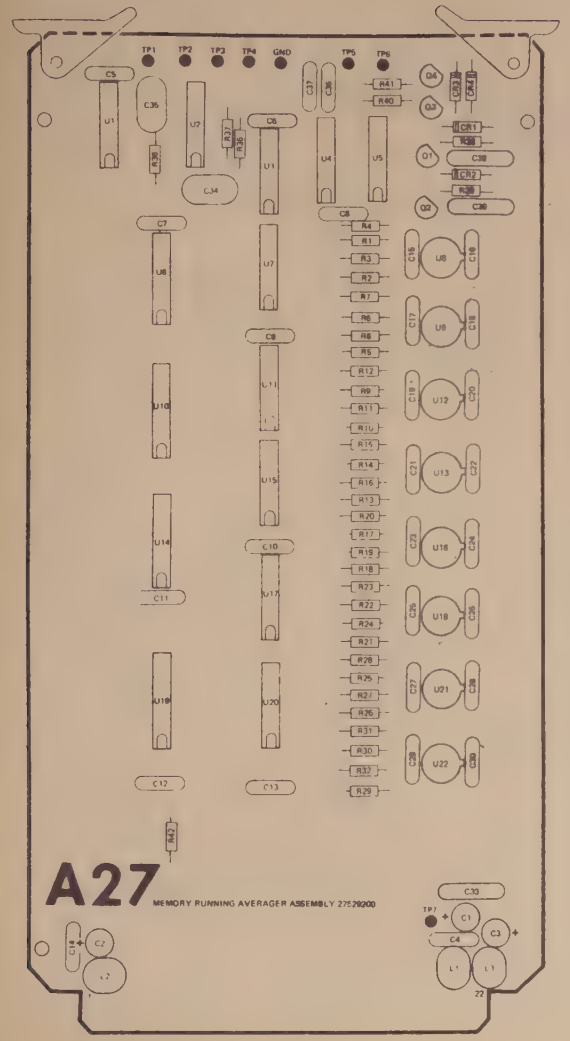
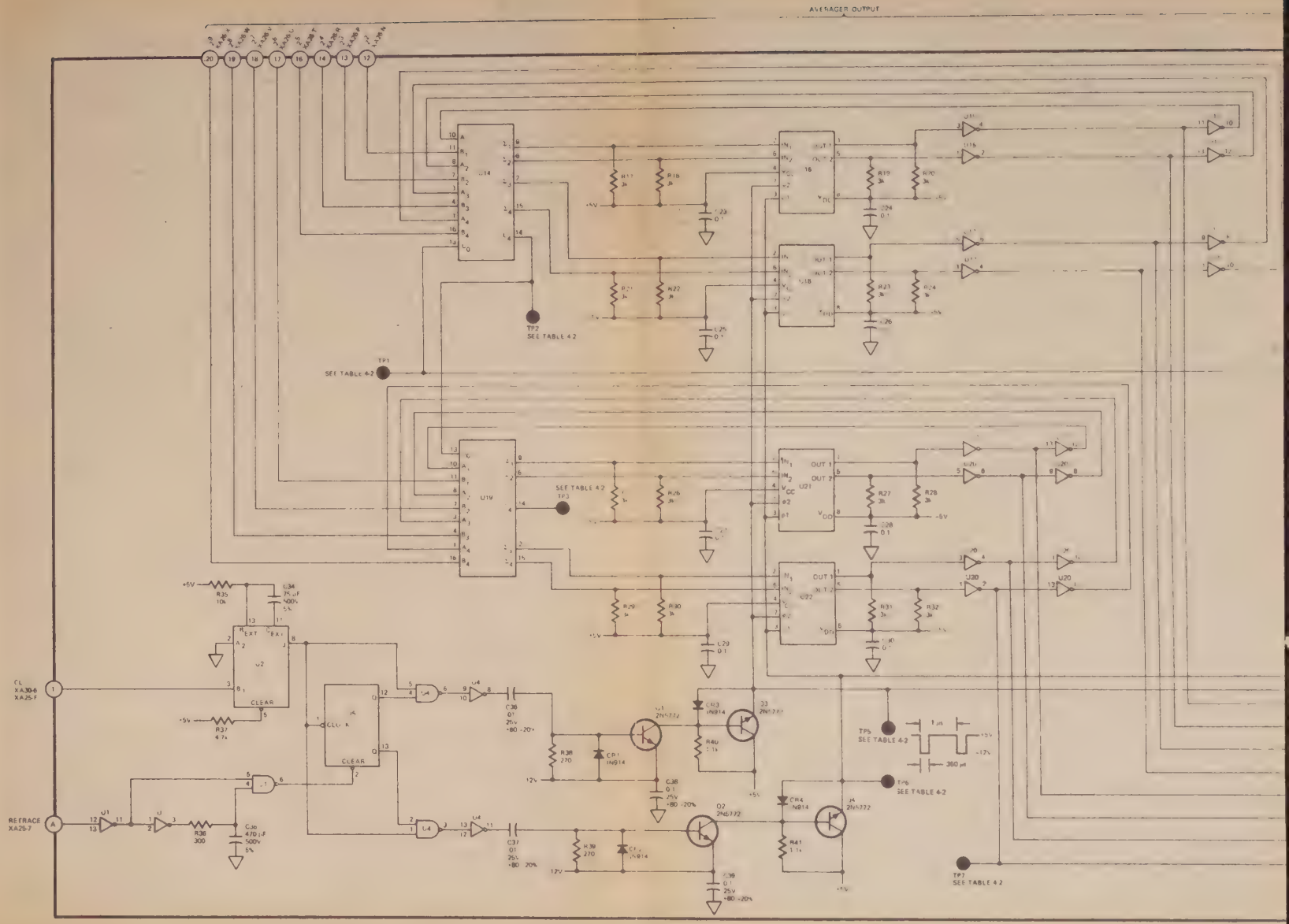
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: SCHEMATIC/COMPONENT LAYOUT ADDERS-RUNNING AVERAGER ASSEMBLY 27527100 A26

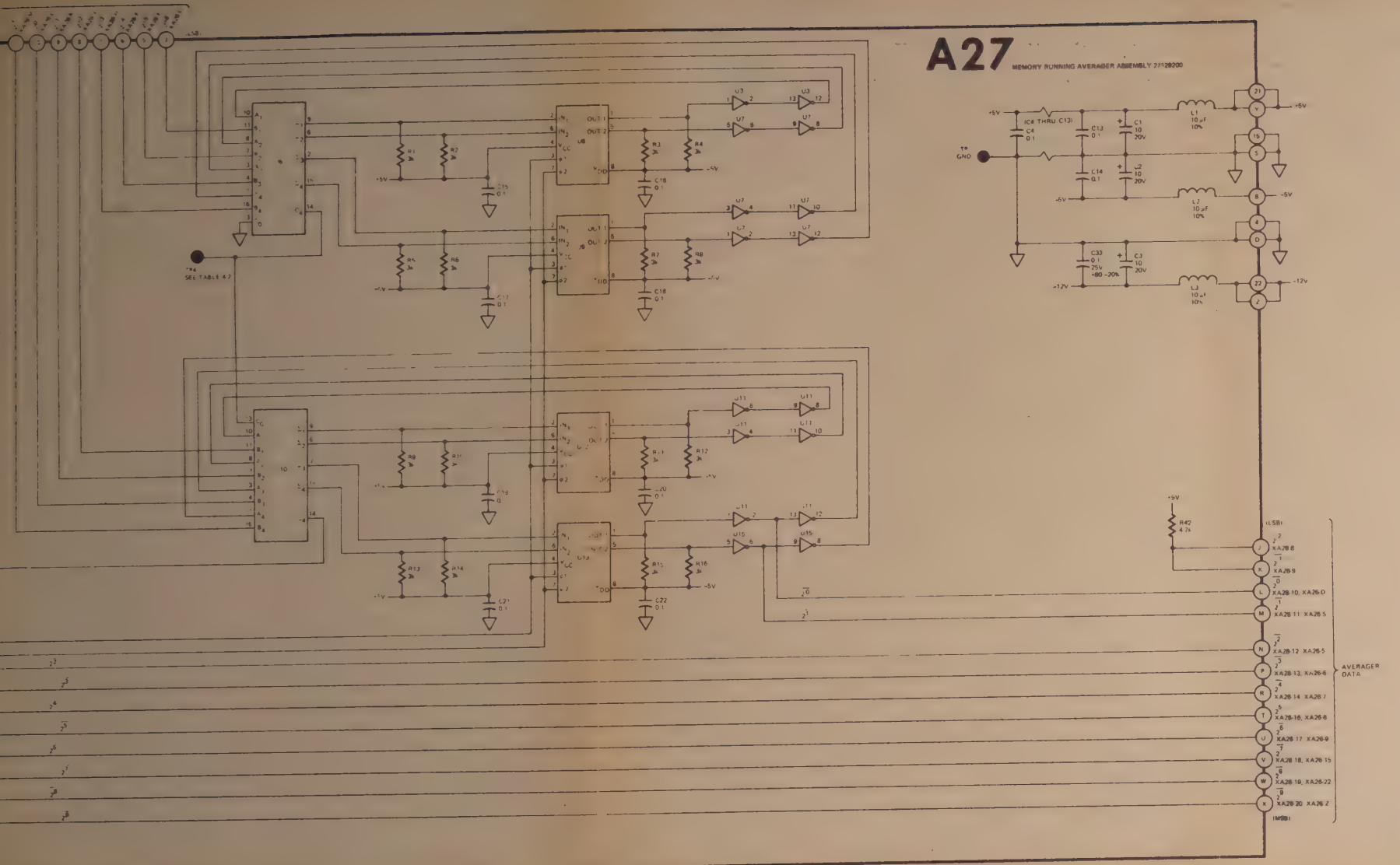
DRAWN	R V McCOY 4-73	MODEL	SIZE	DRAWING NO	REV
DESIGNER		13151		27527200	A
CHECKED					
ENGINEER		SCALE		SHEET 1 OF 1	
APPROVED					


TP1
TP2
TP3
TP4
GND
TP5
TP6
A27
MEMORY RUNNING AVERAGER ASSEMBLY 275292OO


AVERAGER OUTPUT
SEE TABLE 4-2
REFRACE XA25-7
+5V
-5V
+12V
-12V

A27

MEMORY RUNNING AVERAGER ASSEMBLY 27529200



REVISIONS							
REV	ECO	S/N	DESCRIPTION	DRAFT			
A		011	REDRAWN	L S 4 73			

NOTES UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/4W, ±5%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS @ 12V ±20%

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1	SN7400N	7	14	U1C
U2	SN74122N	7	14	NONE
U3,U7,U11 U15,U17 & U20	SN7404N	7	14	U3B & U3E
U4	SN7437N	7	14	U4B
U5	SN7473N	11	4	NONE
U6,U10,U14 & U19	SN7483N	12	5	NONE
U8,U9,U12 ,U13,U16, U18,U21 & U22	1403A	8	4	NONE

HIGHEST REF DESIG USED
L3
CR4
L3
Q4
R42
TP7
U22

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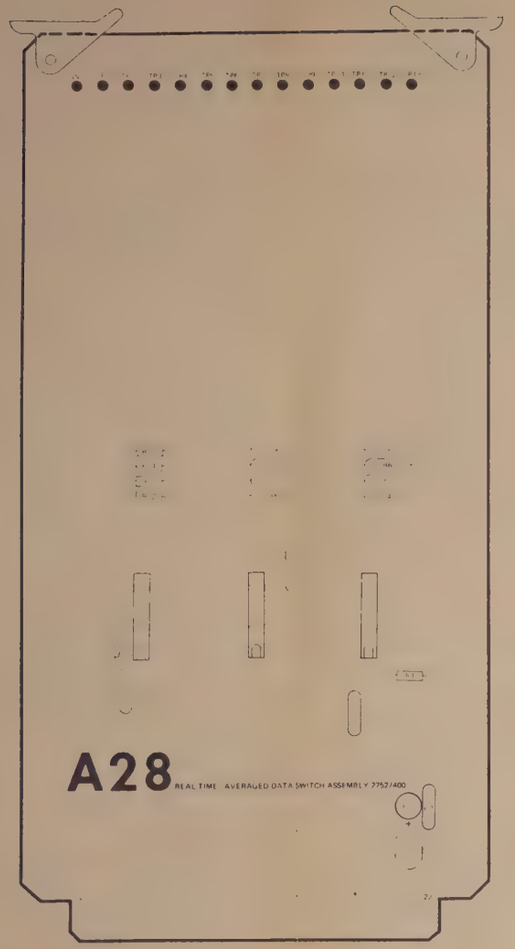
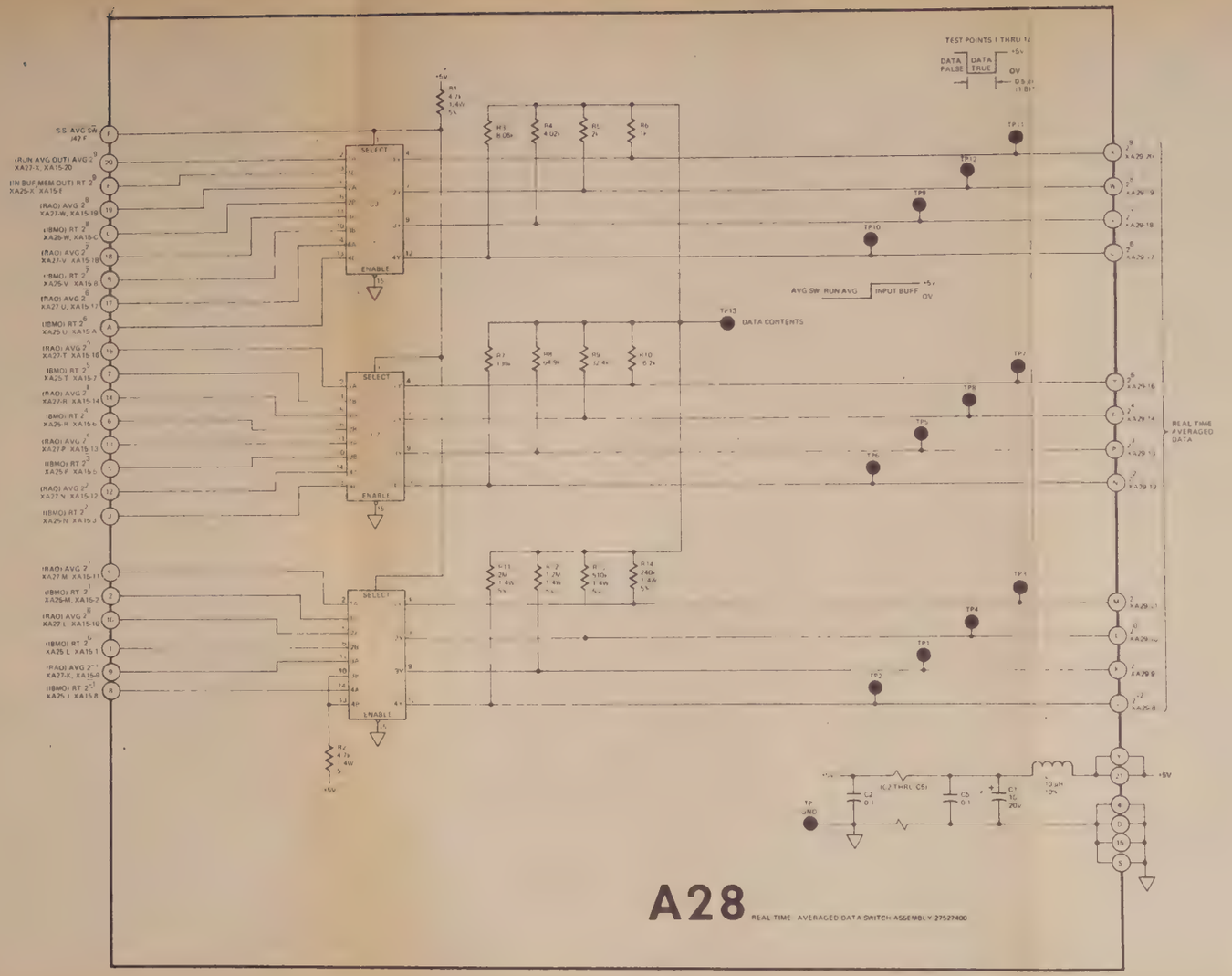
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: SCHEMATIC/COMPONENT LAYOUT MEMORY RUNNING AVERAGER ASSEMBLY 27529200

A27

DRAWN	L SAUER	4 73	MODEL 13151	SIZE	DRAWING NO 27529300 REV A
DESIGNER					
CHECKED					
ENGINEER			SCALE		SHEET 1 OF 1
APPROVED					





REVISIONS						
A		MH	REDRAWN	3/73		

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/8W, ±1%
   (c) CAPACITANCE SHOWN IN MICROFARADS
   (d) CAPACITORS @ 12V, ±20%

INTEGRATED CIRCUITS				
REF DESIG	PART NO	PWR PINS GND	PWR PINS VCC	UNUSED CIRCUITS
U1 U3	SN74157N	8	16	NONE

HIGHEST REF DESIG USED
C1
L1
R14
TP11
U3

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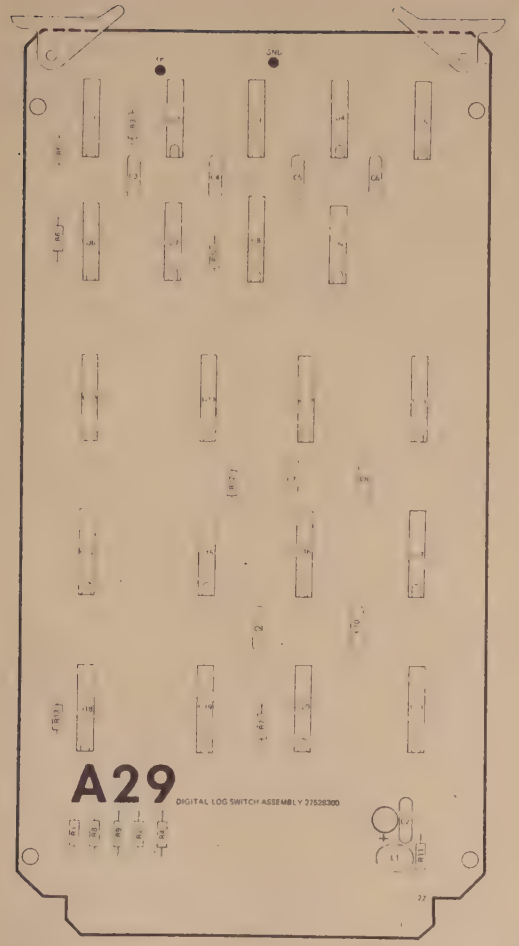
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

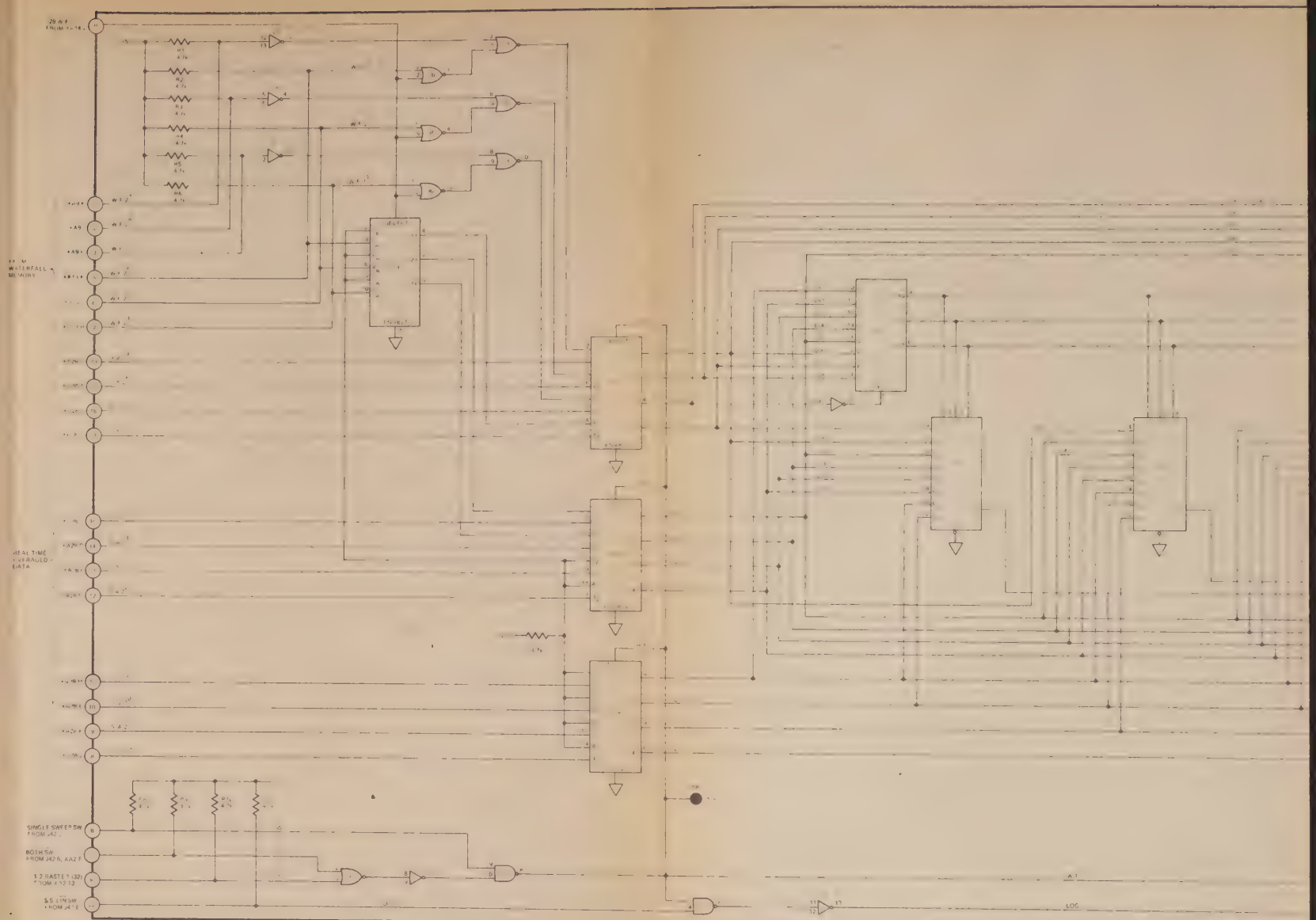
TITLE: SCHEMATIC/COMPONENT LAYOUT
REAL TIME-AVERAGED
DATA SWITCH
ASSEMBLY 27527400
A28

DRAWN	L SAUER	3/73
DESIGNER		
CHECKED		
ENGINEER		
APPROVED		

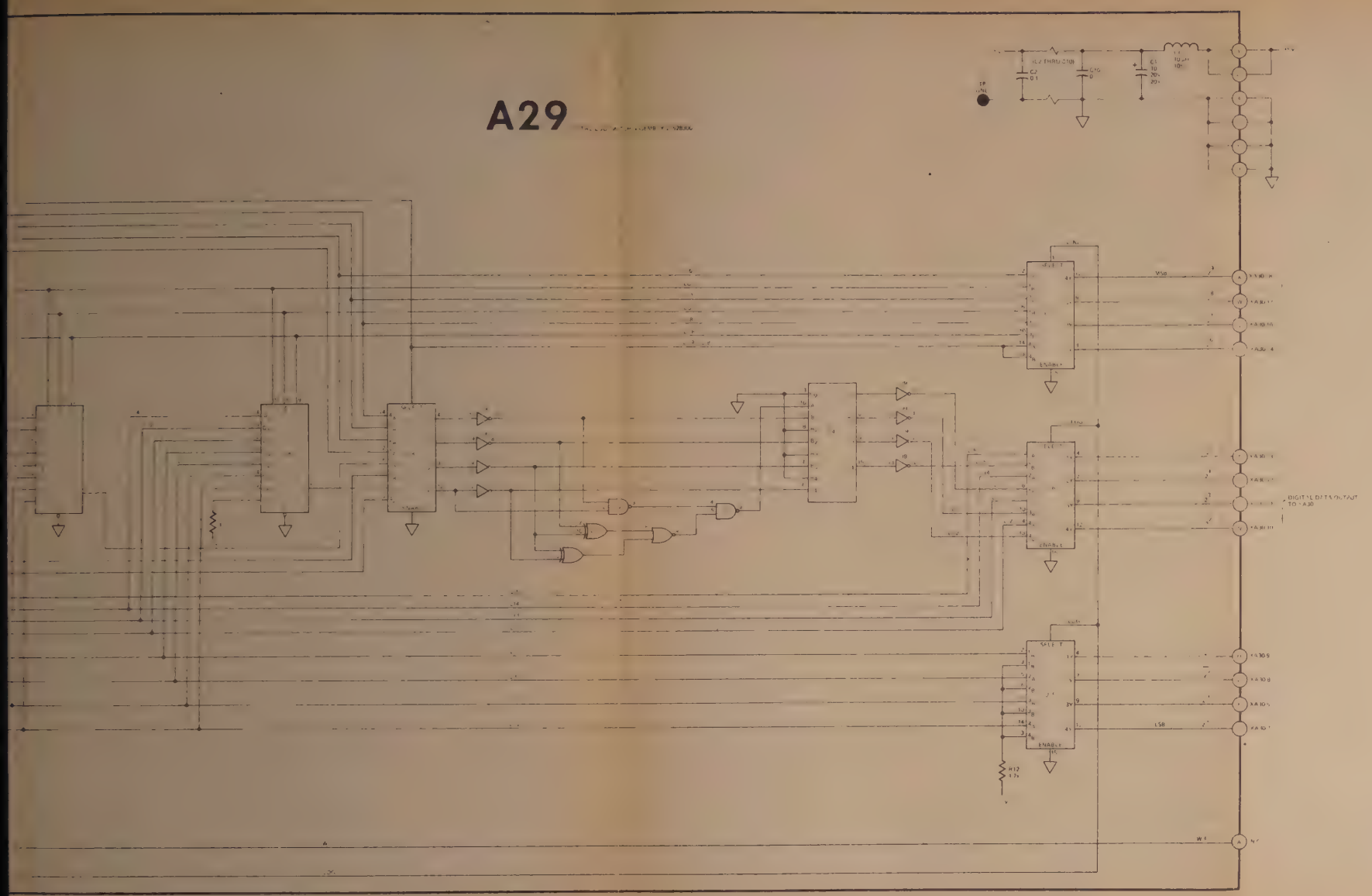
MODEL	SIZE	DRAWING NO	REV
13151		27527500	A

SCALE | SHEET 1 OF 1


A29
DIGITAL LOG SWITCH ASSEMBLY 2752830D



A29



REVISIONS						
A		0-1	REDRAWN		RVM 1-13	

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4W, 5%
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS @ 12V ±10%

INTEGRATED CIRCUITS

REF. DESIG.	PART NO.	PWR PINS GND	PWR PINS +5V	UNUSED CIRCUITS
U1,U6,U7	SN7402N	7	14	NONE
U2,U3	SN7400N	7	14	NONE
U4	SN7483N	12	5	NONE
U5	SN7486N	7	14	USA & B
U8,U10,U15 L16,U17,U19 U20 & U21	SN74157N	8	16	NONE
U9	SN7404N	7	14	NONE
U11,U12,U14 & U18	SN74151N	8	16	NONE
U13	SN74148N	8	16	NONE

HIGHEST REF DESIGNATION
10
C1
R13
TP1
U21

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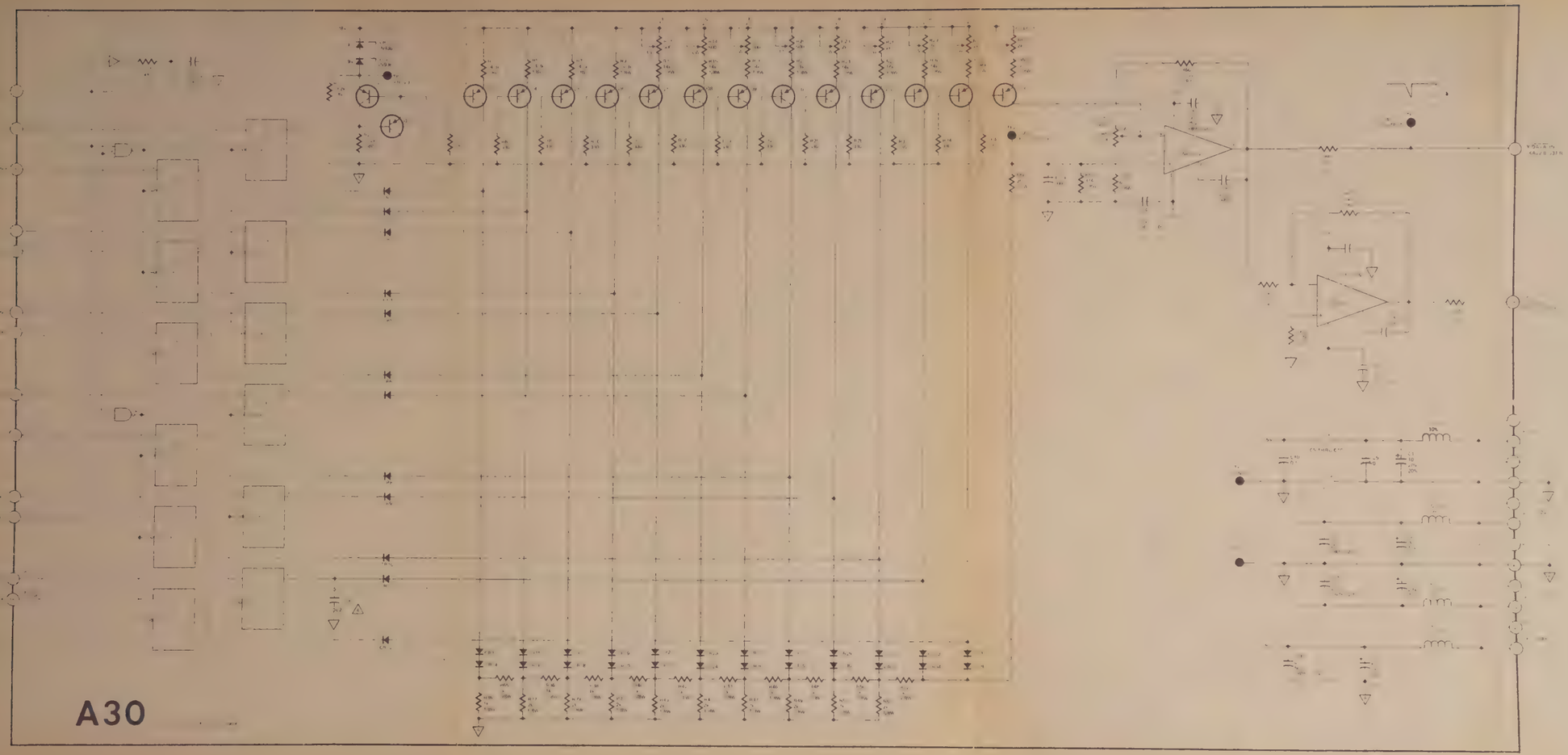
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

DRAWN	R. V. McCOY	3-73
DESIGNER		
CHECKED	F. KNOX	
ENGINEER		
APPROVED		

TITLE: SCHEMATIC/COMPONENT LAYOUT
DIGITAL LOG-SWITCH
ASSEMBLY 27528300
A29

MODEL	SIZE	DRAWING NO	REV
13151		27528400	A

SCALE | SHEET OF

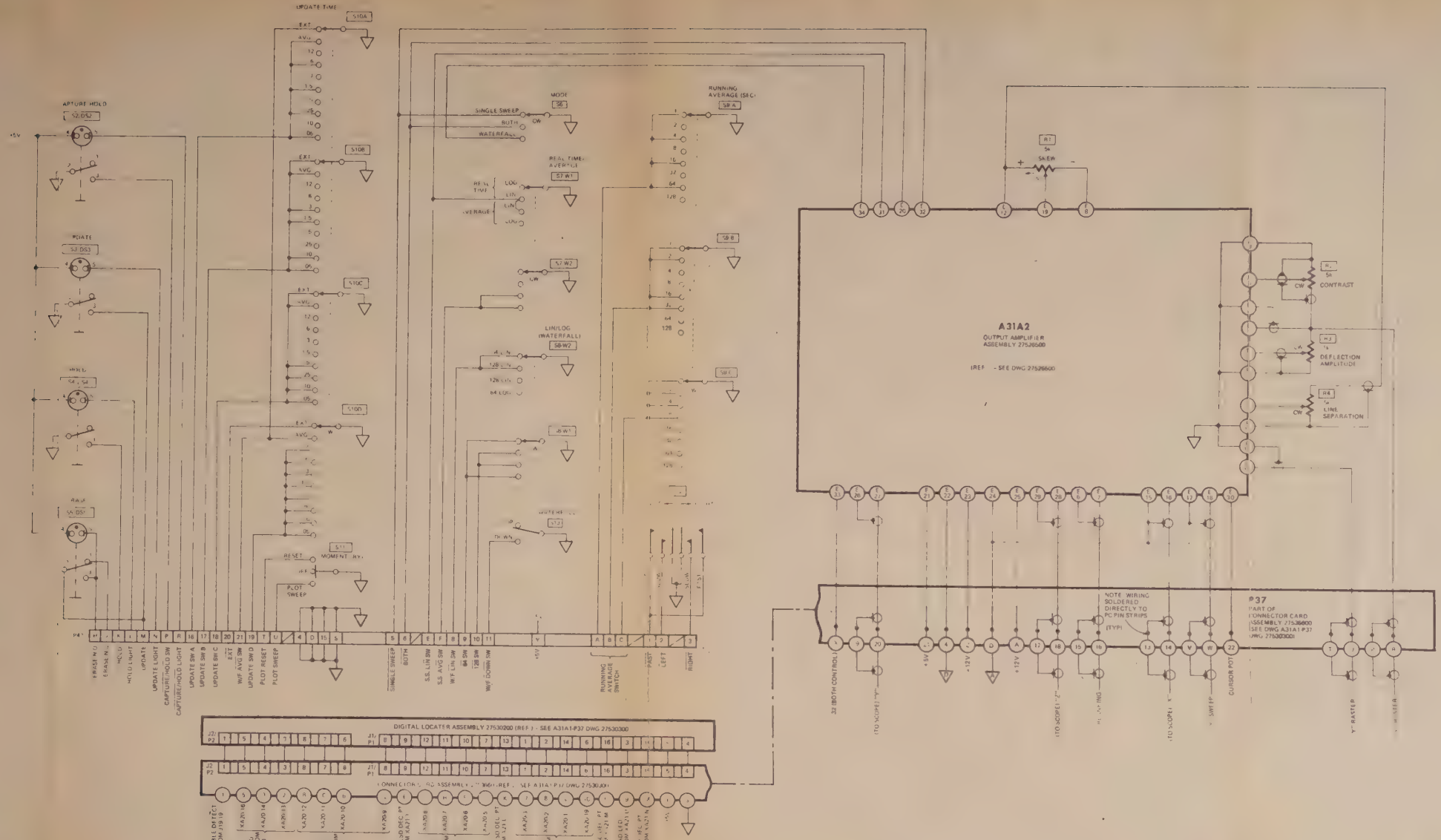


A30

SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

SCHEMATIC COMPONENT LAYOUT
12 BIT LADDER
ASSEMBLY 27528600

A30



NOTES: UNLESS OTHERWISE INDICATED
1. POTENTIOMETERS SHOWN IN OHMS
2. SYMBOL [ ] INDICATES FRONT PANEL LOCATION

REVISIONS

REV			DESCRIPTION	DRAWN		
A		011	REDRAWN	RVM 4/73		

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SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

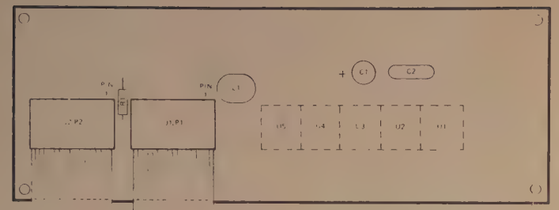
DRAWN	R.V. McCOY	4/73
DESIGNER		
CHECKED		
ENGINEER		
APPROVED		

TITLE: INTERCONNECT DIAGRAM FRONT PANEL ASSEMBLY

A31

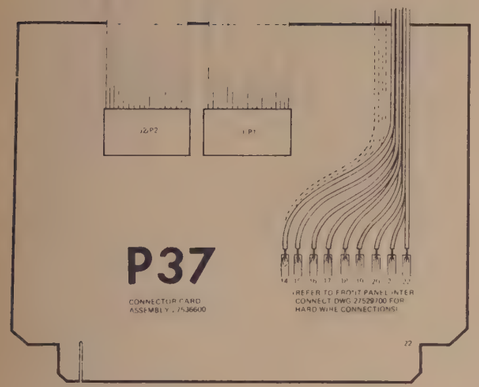
MODEL	SIZE	DRAWING NO	REV
13151		27529700	B

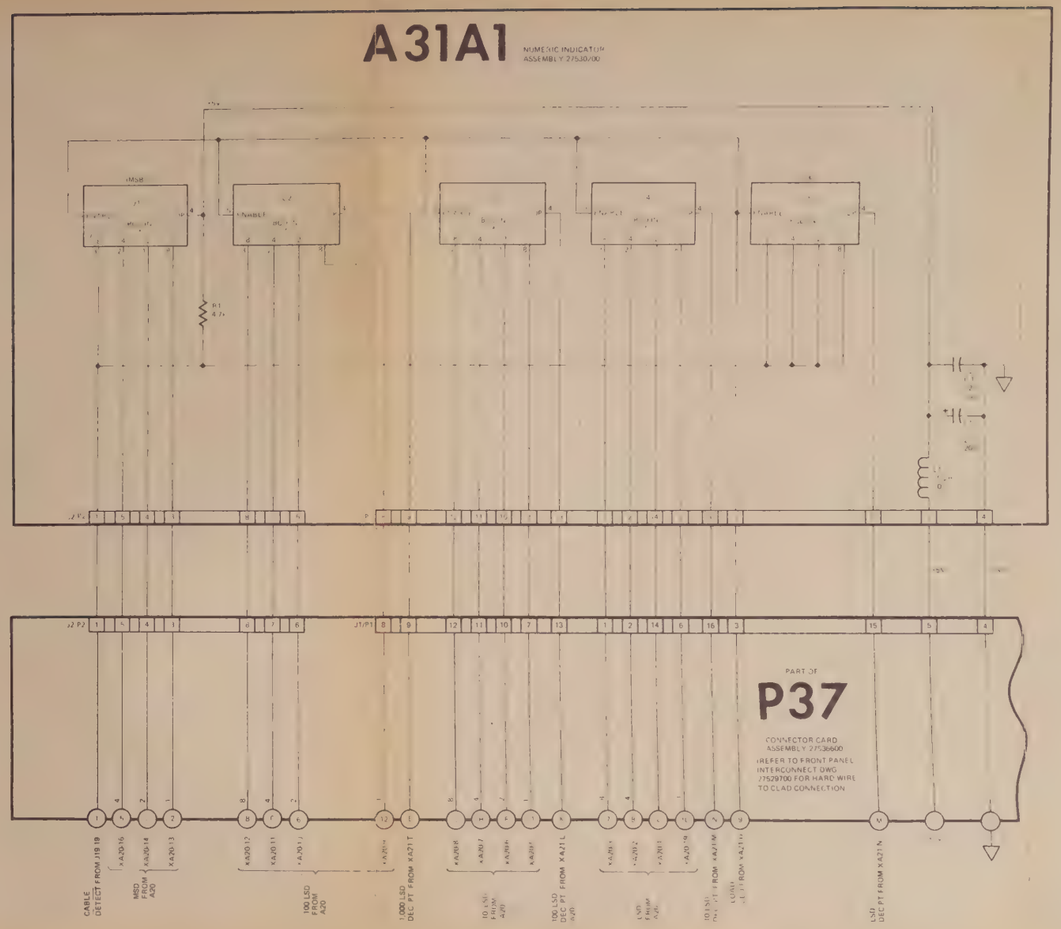
SCALE | SHEET OF



A31A1

NUMERIC INDICATOR
ASSEMBLY 27530200





REVISIONS						
LTR		ZONE	DESCRIPTION		DATE	APPROVED
A		011	RELEASED		4/73	

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4W 5%
(c) CAPACITANCE SHOWN IN MICROFARADS

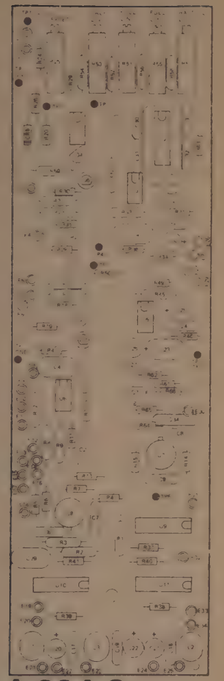
INTEGRATED CIRCUITS A31A1

REF DESIG	PART NO	PWR PINS +	PWR PINS -	GROUND PINS
U1 U2 U3 U4 & J1	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] REF DESIG USED

[illegible] is the property of [illegible] and is loaned subject to return on demand. [illegible] patentees, agrees that it [illegible] at whose [illegible]

SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO		TITLE: SCHEMATIC/COMPONENT LAYOUT NUMERIC INDICATOR ASSEMBLY 27530200 & FRONT PANEL CONNECTOR CARD ASSEMBLY 27536600	A31A1 P37
DRAWN: R V MOCLY 4/73		MODEL: 13151	SIZE:	DRAWING NO: 27530300	REV: A
DESIGNER		SCALE:		SHEET: OF
CHECKED				
ENGINEER				
APPROVED				



A31A2 OUTPUT AMPLIFIER ASSEMBLY 27526500

A31A2 OUTPUT AMPLIFIER ASSEMBLY 27526500

REVISIONS					
LTR	ECO	BY	DESCRIPTION	DATE	APPROVED
A			RELEASED		
B	10048	WR	ECO ECE		
C	10074A		ECO ECE		
D	1815	DH	ADDED C7, C34, R84 THRU R88 DELETED. R60, CR2, CR3, CR4, R1 AND R22 WERE 1K. R3 WAS 20.2K, R48 WAS 5K.		

NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4W ±5%
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS @ 25V, +80 -20%
2. SYMBOL ▭ INDICATES FRONT PANEL LOCATION.

INTEGRATED CIRCUITS

REF DES	TYPE NO	MANUFACTURER	INDUSTRY STANDARD
U1			NONE
U2			NONE
U3			NONE
U4			NONE
U5			NONE
U6			NONE
U7			NONE
U8			NONE
U9			NONE
U10			NONE
U11			NONE
U12			NONE
U13			NONE

HIGHEST REF DES. USED

R	88
C	34
L	3
CR	5
Q	8
U	13
TP	7

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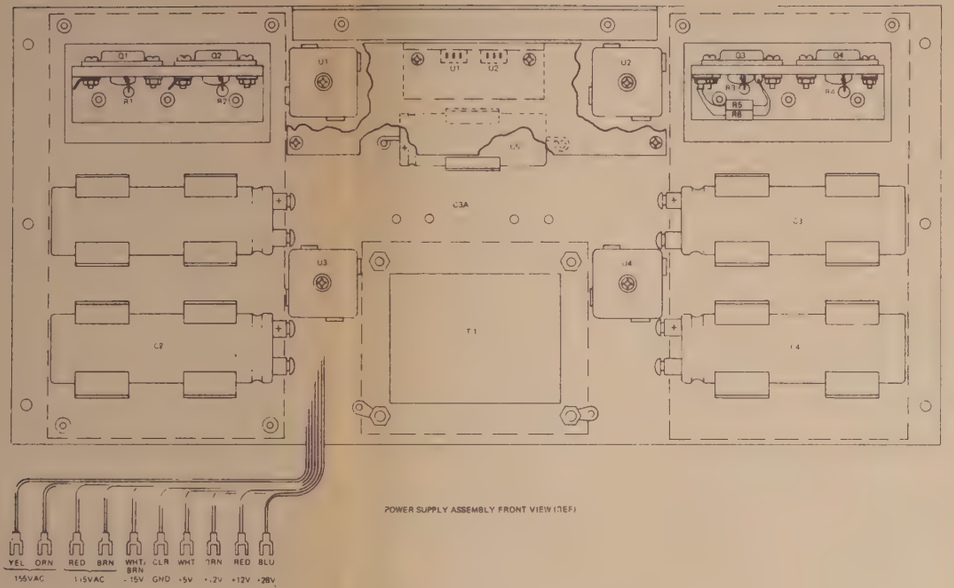
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

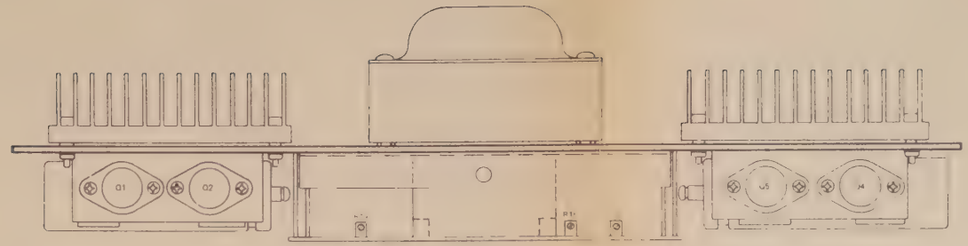
TITLE: SCHEMATIC/COMPONENT LAYOUT OUTPUT AMPLIFIER ASSEMBLY 27526500 A31A2

DRAWN	R.C. McCOY	7-13
DESIGNED		
CHECKED		
ENGINEER		
APPROVED		

MODEL	SIZE	DRAWING NO	REV
13151		27526600	D
SCALE		SHEET	OF

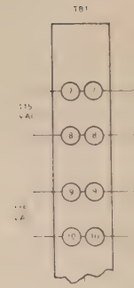


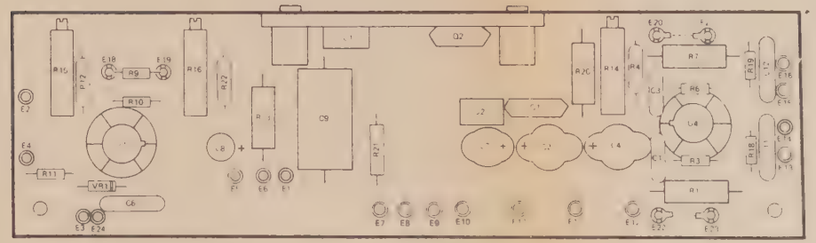
POWER SUPPLY ASSEMBLY FRONT VIEW (REF)



A32

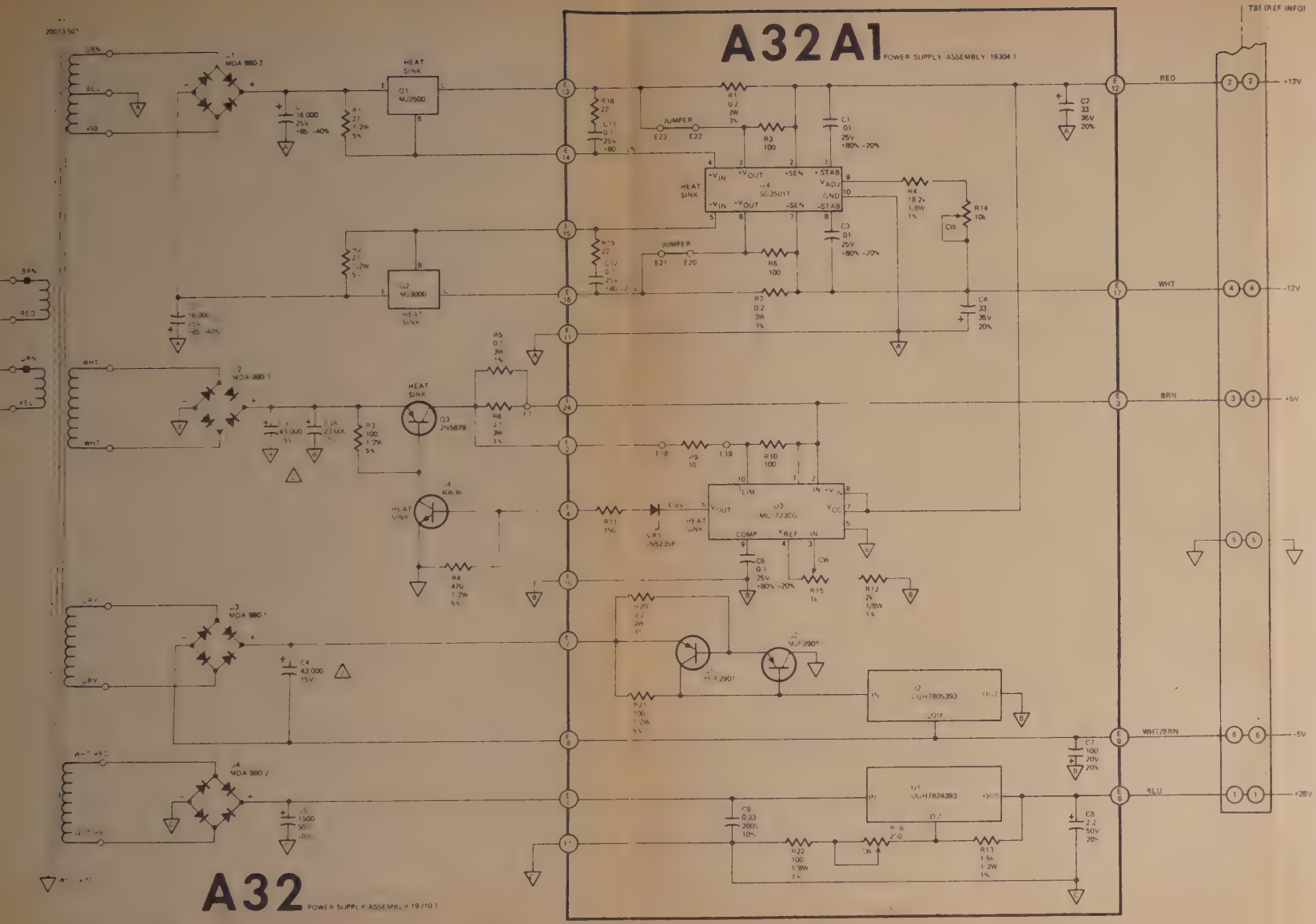
POWER SUPPLY ASSEMBLY 19310-1
TOP VIEW (REF)





A32A1

POWER SUPPLY ASSEMBLY 19304-1



REVISIONS						
REV	ECO	S/N	DESCRIPTION	DRAFT		APP
C		011	REDRAWN	RVM 3 73		

NOTES: UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS
   (b) RESISTORS ARE 1/4W, 5%
   (c) CAPACITANCE SHOWN IN MICROFARADS
2. ALTERNATE CAPACITOR COMBINATIONS LOCATED BELOW MAY BE USED

C2	C3	C4
43,000 µF	NOT USED	43,000 µF
22,000 µF	43,000 µF	33,000 µF
10,000 µF	NOT USED	10,000 µF

HIGHEST REF DESIG USED
A32
A1
C5
C4
R6
T1
U4

HIGHEST REF DESIG USED
A32A1
C10
E6
E7
C4
VR1

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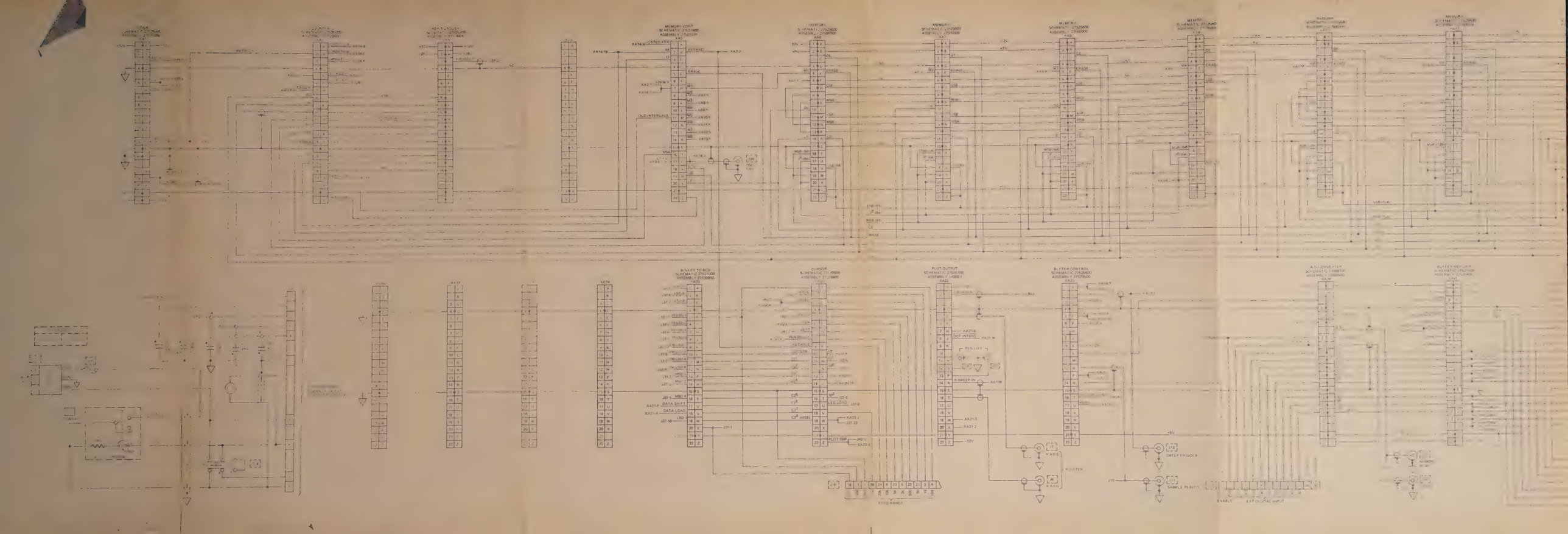
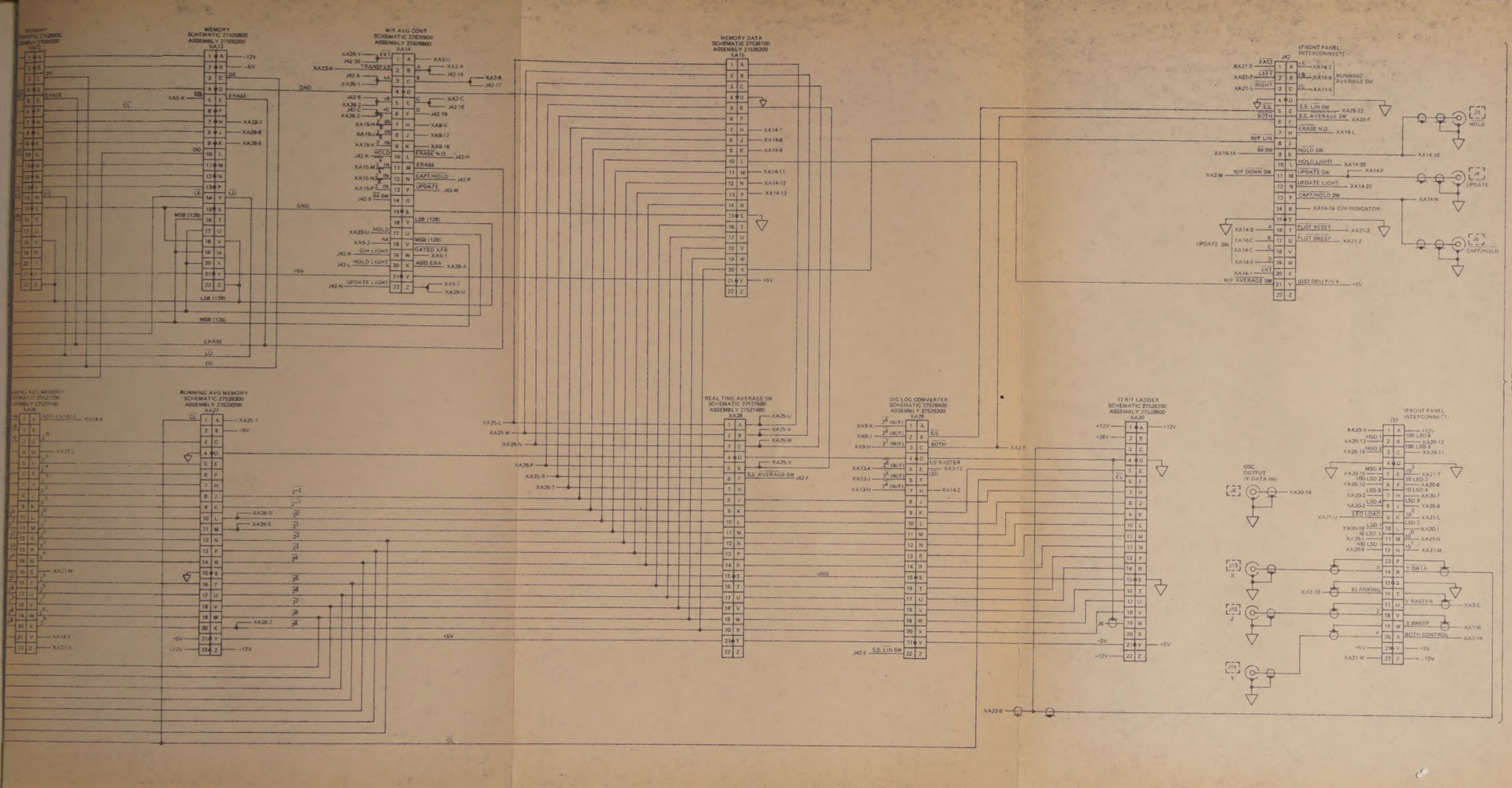
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

TITLE: INTERCONNECT DIAGRAM POWER SUPPLY ASSEMBLY (P.C. ASSEMBLY 19304-1, A32A1) A32

DRAWN	R V McCOY	3 73
DESIGNER		
CHECKED		
ENGINEER		
APPROVED		

MODEL	SIZE	DRAWING NO	REV
13151		27533700	C
SCALE		SHEET 1 OF	





REVISIONS						
REV	ECO	S/N	DESCRIPTION	DRAFT	CHECK	APPD
D	—	011	REDRAWN	L.S. 4-73		
E	10073	011	CHANGED POWER CKT	P.H. 8-73		
F	1661	011	SEE ECO	GBC 2-74		
G	1794	026	ON A24 THE SCHEMATIC NO. WAS 27520100 & THE ASSEMBLY NO. WAS 27520000.	L.S. 9-74		
H	DDC	—	ADDED CON AT J1B-35, 36. REC. 3729.	GBC 7-75		

TABLE OF MNEMONICS	
MEANING	MEANING
C	CURSOR DATA
DE	DISPLAY EVEN
DO	DISPLAY ODD
LED	LIGHT EMITTING DIODE
LI	LOG IN
LO	LOG OUT
LSB	LEAST SIGNIFICANT BIT
LSD	LEAST SIGNIFICANT DIGIT
MS	MEMORY SYNC
MSB	MOST SIGNIFICANT BIT
MSD	MOST SIGNIFICANT DIGIT
SS	SINGLE SWEEP
ST	SWEEP TRIGGER
W/F	WATER FALL

NOTES: UNLESS OTHERWISE INDICATED

1. (a) RESISTANCE SHOWN IN OHMS.
   (b) RESISTORS ARE 1/4W, ±5%
   (c) CAPACITANCE SHOWN IN MICROFARADS.
   (d) CAPACITORS @ 25V, -10 +75%.
2. SYMBOL ▭ INDICATES FRONT PANEL LOCATION.
3. SYMBOL ▭ INDICATES CHASSIS LOCATION.

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SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

DRAWN	L. SAUER	4-73
DESIGNER		
CHECKED	P. HOLMES	8-73
ENGINEER	P.	8-73
APPROVED	P.H.	8-73

TITLE: INTERCONNECT DIAGRAM MAIN FRAME ASSEMBLY

A33

MODEL	SIZE	DRAWING NO.	REV
1315		27529900	H

SCALE — SHEET 1 OF 1